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The Impact of Trade sanctions on the Iranian Economy

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Abstract:

This study investigates the effect of economic sanctions on Iran's macroeconomy. To achieve particular objectives, the US and UN often choose sanctions over war and most politicians believe that these two options have the same level of effectiveness. Moreover, sanctions are used more and more to put pressure on the target country and force the country to meet the particular objectives. However, the literature and history has demonstrated that the effectiveness of sanctions tends not to be high. This study determines the effectiveness of the sanctions imposed on Iran and investigates the effects of sanctions on important macroeconomic variables during a specific time period. The variables included are the main variables in the macroeconomy, in particular, oil exports are included due to the fact that its is an important aspect of Iran's economy as it is a large oil exporting country and also the main target for the sanctions. Because of the importance of the oil sector, the sanctions imposed on Iran have focused more and more on Iran's oil exports. Sanctions on Iran were started by the US unilaterally and later accompanied by the UN and the EU and became multilateral. In this study `I have presented a brief history of the Iranian economy and how the Central Bank of Iran operates. In the three empirically based chapters, different approaches are used to analyses the effect of sanctions on the economy. First the vector autoregressive approach is used with impulse response functions and variance decompositions and the findings shows that shocks to oil exports have more effect on the exchange rate than the other variables and the budget deficit and imports are less likely to be affected. Next a two regime Markov switching model is used to determine the reaction of the variables in two states of sanctions and where there are no

sanctions. Thirdly I have investigated the exchange rate misalignment in Iran and determined the existence of the deviation. In general, the findings show that the main macroeconomic variables that have been affected the most are the exchange rate and also inflation. But GDP and oil exports are affected less in comparison with the exchange rate.

Chapter 1: Introduction

The aim of this study is to analyse the effects of sanctions on the Iranian economy and whether the sanctions have had a significantly negative effect on the key macroeconomic variables. Iran was chosen as it is a good example of a country reacting to specific sanctions and due to its unique historical and geographical situation and the unique international sanctions imposed on the country. Different countries around the world use sanctions as an economic and political tool in order to change the behaviour of a targeted country. Previous research has analysed whether sanctions are effective or ineffective and moreover the impact of the sanctions. Sanctions on Iran are most important to the banking and energy sector, especially the oil sector (Shaeri et al. 2016) and Iran has been one the largest oil producers and oil exporters and has historically provided crude oil for many countries around the world, so is a good example of the implications of sanctions on oil exporters. In addition, oil is an essential aspect of the international political economy, in terms of wealth and the wider effects on the environment, as recently efforts have been made to reduce its consumption to prevent climate change. However, politically the sanctions have been the concern of many other countries over recent years. The US and other countries started imposing sanctions on Iran after the revolution in the late 1970s and more recently to stop its nuclear program. Sanctions have been used around the world as a force to gain specific political objectives and are also a tool for foreign policy (Yavari et al. 2009). Economic sanctions are considered as an alternative to war and are also less costly. Askari et al. (2003) defined sanctions as "coercive *measures imposed by one*

country or coalition of countries against another country, its government or individual entities therein, to bring a change in behaviour of politics."

Sanctions can be imposed unilaterally from one country or multilaterally from more than one country, as Iran has experienced. The first sanctions were imposed by Athens in 432 B.C. The United Nation first applied sanctions in 1963 on South Africa and by the mid 1980s the economic growth of this country fell by a half and they reached an agreement with the UN. However, the US imposed economic sanctions against Cuba in 1960 and against Rhodesia in 1966.

Economic sanctions have been argued to have effects on economic and political behaviour (Hufbauer et al. 2009). The effect of sanctions on the sender are limited and depend on the situation of the targeted country and how the sanctions are imposed. As I am mainly interested in the effectiveness of the sanctions on Iran, I focus on how the sanctions affected the economy and welfare in Iran**.** Hufbauer (2009) suggested that economic sanctions are successful 33% of the time and the effectiveness of sanctions reduces in the long run in terms of changing the political behaviour of the targeted government. This reduction in successfulness of sanctions in the long run can be due to the fact that the targeted country usually tries to offset the effects on its economy. For example, in the case of Iran, the imposing of sanctions on the oil sector reduced the government's oil revenue and the government tried to offset this reduction by reforming subsidies and increasing tax. However, leaders continue imposing sanctions.

Some studies have suggested that sanctions can even make the target country stronger, whereas the target country must be made more vulnerable by the sanctions if it is to be forced to agree with the sender (Allen 2005 and Souva 2007). Overall sanctions that have more costs on the

target country are more likely to be successful (Drury 1998). However, if the sender and the target countries are trading partners then the sanctions are more likely to be effective and if they are not important trading partners then the target country can offset sanctions by switching to other countries. To prevent this happening, international collaboration is essential (Martin 1992). This also usually means that unilateral sanctions are not as successful as multilateral sanctions. Iran has used this strategy of switching trading partners to offset the imposed sanctions, however it is not clear how effective this policy has been. One if the issues of multilateral sanctions are that there may be disagreements between the senders which again has happened with the sanctions imposed on Iran. We can see that for example for some years EU countries were opposed to the US sanctions imposed on Iran and did not cooperate with the US, which was beneficial for Iran. Once sanctions are in place the targeted country applies strategies to offset the effects of the sanctions (Early 2009). These strategies may be beneficial for the third parties who are the new partners of the targeted country. Allen (2005) noted that sanctions that focus on regime change are less likely to be successful. Bahrami (2012) found that sanctions' effects on changing the behaviour of a government tend to be poor and mostly it's the population that suffers from the pressure of the sanctions.

1.1- Motivation and contribution:

Oil is the main source of energy across the world (more than 75%) since the mid 1950s and changes in oil prices can affect both oil exporters and oil importers and some countries are heavily dependent on oil and oil products. The oil supply has tightened in the past years mostly due to political decisions around the world such as sanctions on Iran which were imposed by the US and the reduction in oil production in Venezuela. These events have reduced the oil

supply and caused an upward trend in oil prices around the world. According to Hamilton (2003), fluctuations in oil prices which are mainly are due to oil supply changes, have a negative effect on the economy. However, Blanchard and Gali (2007) suggested that oil prices and economic growth relationships are less important and determined that there is a more significant effect of oil price fluctuations on inflation in the 1970s rather than the 2000s (IMF report, 2017). Oil has a significant role in the economic cycle and its fluctuations have a significant effect on the global economy such as causing spikes in inflation and interest rates which happened in the US in 2008.

The first studies analysing the effectiveness of sanctions were in the 1980s and 1990s (Hufbauer 1990). This study contributes to the literature by including a variety of macroeconomic factors into the modelling of sanctions such as the exchange rate, oil exports, imports, budget deficits and inflation. In addition, we analyse the effects using a variety of approaches not used previously which account for the non-linear nature of this relationship. However, as the number of instances of using sanctions has increased around the world, the literatures' focus has shifted from the effectiveness of sanctions to policymakers' decisions about using sanctions. A few studies argue that sanctions are used by leaders to gain domestic political support (Whang 2011). Although many studies determine that the sanctions' effectiveness is marginal but there is some efficacy in some cases.

The US encouraged international sanctions on Iran to achieve its political objectives, with the sanctions imposed on Iran changing constantly. I have chosen Iran because firstly sanctions imposed on Iran were worldwide from many countries such as the US, EU countries and also

the United Nations. Secondly there are not that many studies on the Iranian economy despite the fact that it is the centre of attention of the international community

Most studies are usually about the developed countries rather than developing countries and also the literature on the Iranian economy and the imposed sanctions are rare. Moreover, studies rarely analyse how the target country may respond to the imposed sanctions. Unlike most of the literature this study is not following the optimist or pessimist perspective of sanctions and it focuses on the empirical effects and responses regarding imposed sanctions. This study focuses on the economic effects of sanctions on Iran's economy. The data used is over an extended time period relative to other studies, limited by its availability and covers the maximum time period. The interest rate which is used in many studies in not included here due to the Islamic nature of the Iranian economy and the tight control of government. Also, rather than focusing on inflation, which has become less of a problem internationally at the moment, I have used oil exports, inflation, exchange rates, GDP, imports and the budget deficit. This study develops a model for the Iranian economy following Esfahani et al (2009) and focuses on oil exports and sanctions to allow me to investigate the effects of these factors on the macroeconomy of Iran.

The US and UN mostly use economic sanctions rather than war to achieve their political objectives such as ending the Libyan oppression against its civilians or ending North Korea's nuclear program. In the case of Iran, they have imposed sanctions to stop Iran's nuclear program. Some believe that sanctions have the same effect as war which has not always been true for example in the case of North Korean sanctions which were not effective. My study analyses the effects of sanctions on Iranian macroeconomy, in particularly on the economic

factors which are most important to the economy such as oil exports. This study investigates the effects of sanctions over time on Iran's macroeconomy.

We can see that sanctions did not force the Iranian government to change its goals as expected and there were always some strategies to bypass the sanctions, however, not offsetting the sanctions completely but they have helped the government to resist changes in its behaviour or economic policies, as other aspects of the economy have adjusted to ensure the effectiveness is limited.

1.2- Summary of chapters:

Following the introduction, the second chapter gives a general view on the background to the Iranian economy and how the most important economic variables such as GDP, CPI and oil exports have changed over the years before and after sanctions were imposed. Moreover, there is a description of the sanctions that Iran has faced since the first sanctions in the early 1980s. We can see the response of oil production to sanctions which is a reduction from 4 million barrels per day to 3 million barrels per day from 2005 to 2013. Iran's central bank reported a reduction of 5.8% in GDP in 2013 and there are significant fluctuations in GDP and inflation. In addition, the monetary and fiscal policy is described in this chapter and presents the Islamic banking approach of the Central Bank of Iran. The third chapter is an empirical study on the effects of sanctions on the economy through the vector autoregression approach and impulse response functions. The Theory of sanctions' importance to oil in the economy is also presented. We can see a fluctuating response of GDP and insignificant response of CPI to oil exports. Moreover, we can see that the exchange rate is more affected than the other

macroeconomic variables, helping to buffer the wider economy from the adverse effects of the sanctions.

The fourth chapter evaluates the Markov regime switching model to investigate the switches between regimes in the presence of sanctions and without sanctions. As we can see oil embargoes have not affected the oil prices and GDP has been slightly negatively affected by the imposed sanctions. However, the exchange rate and inflation are affected. The fifth chapter investigates the exchange rate and presents the exchange rate system in Iran. Both official and black-market exchange rates have been studied in this chapter and exchange rate misalignment has been discussed and the inefficiency of monetary policy has been shown to occur. We can see deviations in the monetary policy and growth in Iran's exchange rate misalignment.

Chapter 2: Background to the Iranian Economy:

2.1- Introduction:

Iran is the second largest economy within the Middle Eastern and North African (MENA) countries and has the fourth largest crude oil reserves in the world according to The World Bank and International Monetary Fund. The Iranian economy is highly dependent on oil revenues and as a result the economy is vulnerable to changes in the oil sector. The most important events that have affected the economy are the Iran-Iraq war, oil price fluctuations and most importantly over a long period of time from the 1980s until now, sanctions and diplomatic isolation. International trade is an important determining factor in economic growth and welfare. Iran's international trade is significantly dependent on its resources and the consequences of internal and external political conflicts along with the economic sanctions imposed on Iran, mostly by the US.

The production and consumption of energy has changed in Iran in comparison to its previous pre-sanctions' situation and these periods of time can be divided to two further periods of time; before 1980 when the first multilateral US sanction was imposed, and after 1980 when US unilateral sanctions continued, extended and tightened and moreover, EU and UN multilateral sanctions were added to US multilateral sanctions. Because of the sanctions and limited foreign investment, production has decreased but consumption has increased because of population growth. The Iranian currency is no longer exchangeable, and as a result corruption has

increased. Imports have become more expensive and a black market has developed in which the actual exchange rate may be more than its official rate (Mohaddes and Pesaran 2013).

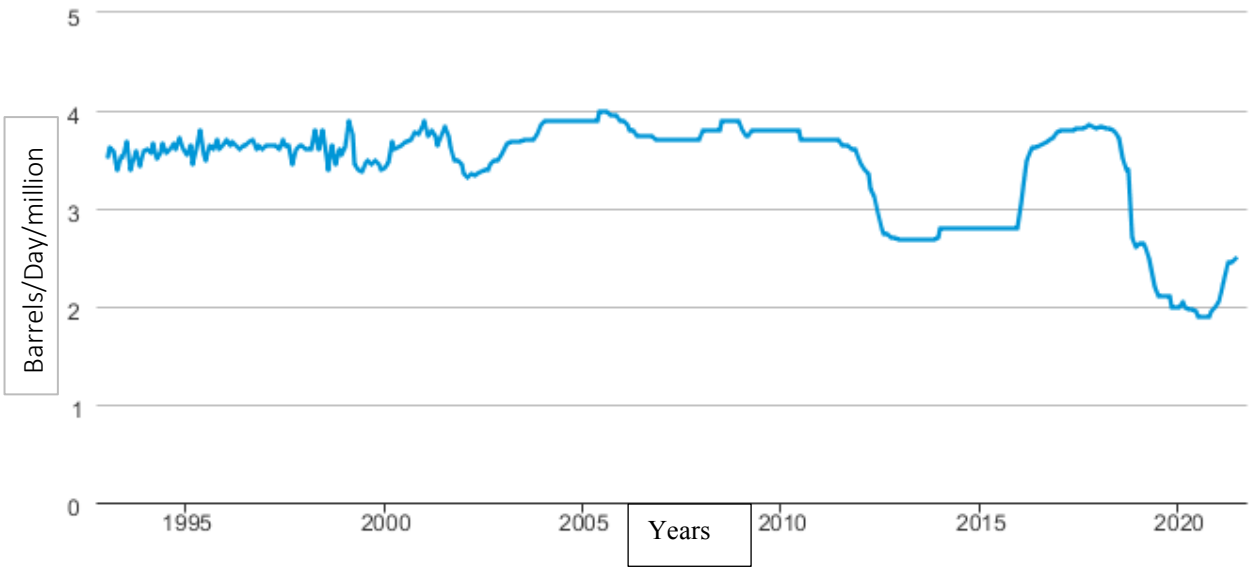
2.2- Oil and the Iranian economy:

According to Mohaddes (2019) 60% of Iran's foreign exchange revenue and 40% of government revenue are from oil exports. Oil started to be produced in 1908 but the level of oil export profits was initially limited and not significant. Oil export revenue became important to the Iranian economy during the 1960s, when there were oil contracts between Iran and international companies, mainly in the UK. According to the World Bank and Central bank of Iran reports Since 1960 the oil revenues have expanded significantly and become an essential source of revenue. In the 1970s the oil price increased, raising substantial oil income for the Iranian economy. In 1979 oil exports halved due to the revolution and since then they have been volatile, mainly due to economic sanctions targeting the oil and gas industry. Iran's oil revenue has been more volatile than oil prices mainly due to economic sanctions which has had a negative effect on production. To deal with the effect of oil price volatility, Iran attempted to set up an oil stabilization fund but this was closed relatively quickly. Oil income volatility then increased from 35 percent per annum between 1960 and 1978 to 51 percent per annum from 1979 to 2010 compared to the oil price volatility which during the same time increased from 11percent per annum to 26 percent per annum (Mohaddes et al 2012).

Oil production in Figure 2.1 has increased significantly since 1960. Oil production peaked in 1974 and has slightly decreased thereafter. Iran exported 5 million barrels of oil per day in 1987, which has since decreased to 2 million barrels per day in 2012. China and India have become the main consumers of Iranian oil and they have increased their demand over recent

years. More recently the US energy information administration has reported a decrease of 875000 barrels per day in Iran's oil production between 2011 and 2014 (Central Bank of Iran).

Figure2.1: Oil production



source: personal collection, Data from central Bank of Iran, IMF and OPEC.

Figure2.2: Oil revenue, percent of GDP:

Source: personal collection, Data from central bank of Iran, IMF and world bank

The income from oil exports relative to GDP presented in figure 2.2 increased to 47 percent in 1974 and the revenue from oil has gradually became more and more important to the Iranian economy. An increase in oil production up until 1975 following the rise in oil prices lead to increases in oil revenues. The oil exports to GDP ratio decreased by around 12 percent from 1979 to 1988, but started to increase slightly afterwards. Oil export revenues have had a rapid increase since 2003 and reached a peak in 2008. But by 2010 it had fallen by about 40 percent relative to its peak before 1979 (Pesaran 2013).

2.3- Before the revolution:

Iran's economy was transformed from being agricultural based to an industrial economy between 1946 and 1979 and experienced sustained growth. The World Bank reported Iran's annual economic growth rate of 9.6 percent per annum during 1960 and 1977 which was double the average growth rate in other developing countries and also was higher than the average growth rate of the developed countries[1]. There was an expansion in the economy and inflation was at its lowest rate until the 1974 oil boom. The Iranian currency was also then at its strongest.

2.4- After the revolution:

According to reports from Central bank of Iran, since 1979 following the revolution, the economy declined significantly and there were significant falls in GDP and a significant rise in inflation. The economic recovery after the end of the Iran Iraq war lasted for only a short period of time. The recovery was short-lived. After the revolution in 1979 Iran faced a deep recession and between 1981 and 1986 there was a period of recovery from this recession. Although there was a mild recession from 1987 to 1989, after 1989 and by the end of the Iran-Iraq war, there was a further recovery. Since the 1980s Iran has faced unilateral sanctions from the US and also the UN, whilst the EU sanctions were imposed on Iran some years later.

Oil prices and economic sanctions are the main factors affecting the Iranian economy, but as in other developing countries, weak economic policies and corruption are also influencing the economy domestically (Pesaran and Mohaddes, 2012). The Multiple exchange rate regime in

[1] World Development Report, World Bank, August 1979. Pp. 128-9

Iran has had many problems and due to this fact, for the improvement of Iran's economic efficiency, the World Bank and IMF indicated a unification of the exchange rates. Under the Rafsanjani leadership Iran adopted some economic reforms in the 1990s including the IMF's recommendations such as privatization and exchange rate unification which were not successful. In 1993 the exchange rate reform was determined by officially pegging the currency. The first reform of economic liberalization was unsuccessful due to barriers and corruption during the process of privatisation. During Khatami's leadership from 1997 to 2005, there also followed a privatization programme, although during Ahmadinejad's leadership this policy was opposed and previous reforms were abolished, which was a factor in the increasing rate of inflation (Central Bank of Iran).

The period after the revolution and the eight years of the Iran-Iraq war were dominated by significant government control over markets and firms and the state mobilization of resources. From 1989 there have been a series of economic reforms, mostly market oriented reforms and following that, the liberalization of the foreign exchange market in 1993, which was not successful and caused a debt and balance of payment crisis (Pesaran, 2000). Between 1900 and 2000 there was a transformation of the Iranian economy in terms of productivity, structure and international trade doubled relative to GDP. Moreover, the capital markets expanded significantly. Since the 1979 revolution, banks started an interest free Islamic framework in which predetermined payments like interest rates are not allowed and it works on a profit and loss sharing basis. However, banks operate like conventional banks and have fixed interest rates regarding loans and deposits which are not associated with the return on deposit sharing (Mazarei 2019). The Central Bank of Iran established maximum deposit rates and credit allocation guidelines and has changed the maximum interest rates many times due to economic

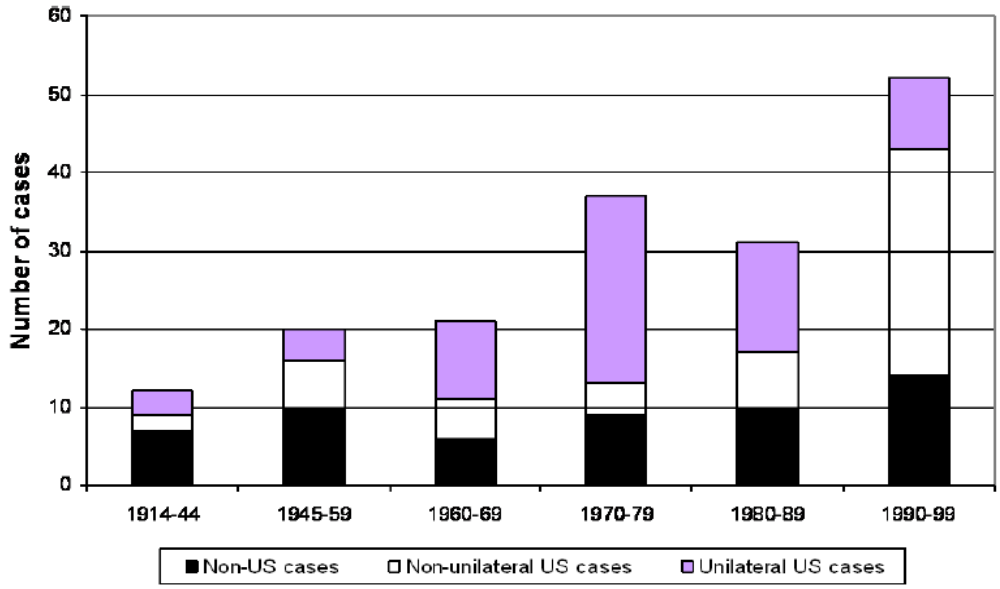
pressures such as sanctions. In 2012 after the sanctions were imposed on Iran, the unofficial black-market rates were increased significantly and have remained unchanged since 2018 when the US reinstated all its sanctions. The Islamic financial framework has limited the monetary tools available to the Central Bank of Iran.

2.5- Economic Statistics:

The United Nations and USA are the most common imposers of sanctions. However, for a sanction to succeed, it needs to include the financial sector, especially international banking. A sanction is considered to work if it accomplishes the goals and objectives specified at the outset. An empirical study by Hufbauer, Schott, Elliott, and Oegg (2010) revealed that sanctions succeeded 23% of the times they are applied but depends on the sanctions' objectives. They define successful sanctions as the partial or full achievement of the aims of imposing sanctions and it should be significantly due to the imposed sanctions. They further argued that sanctions often deter future misbehaviour. Also, they believe that applying trade and financial sanctions together are more effective than applying only trade sanctions. They define that sanctions are more likely to be effective when the target country is democratic or friendly and there are limited goals. The number of economic sanctions has increased overtime, as is evident in the figure below, which is a brief summary of the trend in economic sanctions.

Arad and Hilliman (1979) believe that trade bans reduce the future costs experienced under sanctions of goods and services by forcing the target country to improve those specific productions and become less reliant on traded goods. Salehi (2015) presented evidence of a nonlinear regime switching behaviour in Iran and found that Iran's economy has had moderate growth after experiencing the 1992 and 1995 recessions.

Figure 2.3: Trends in Economic Sanctions



Source: Peterson Institute for International Economics

The number of economic sanctions has increased tremendously since 1914 in the world. The USA has pursued most of the sanctions as can be seen by the increasing number of unilateral and non-unilateral US cases. The table below summarizes the principal senders and targets of the economic sanctions by regions. The table indicates that the USA has applied economic sanctions more than any other country in the world.

Table2.1: Principal Senders and Targets

Principal Senders			Principal Targets		
	1970-89	1990-99		1970-89	1990-99
USA	25	38	Africa	5	18
EC/EU	5	19	Asia	7	8
USSR/Russia	0	6	Latin America	10	8
UN	1	11	Middle East	4	3
			USSR/RSU	3	8

Source: Peterson Institute for International Economics

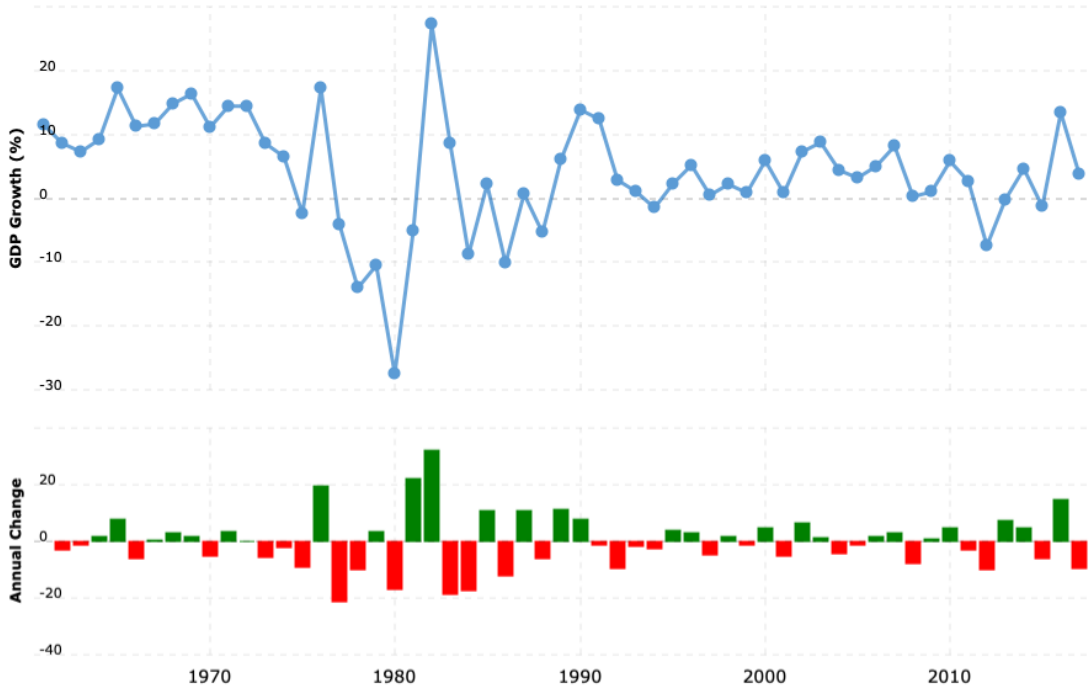
According to data from the IMF, CBI AND world Bank the performance of Iran's GDP growth over the previous 55 years is demonstrated in figure 2.3 and is taken from the Central Bank of Iran's statistics. A year before the revolution in 1979 the economy began to have a downward trend and continued its downward trend after the revolution. During the revolution the government took over and nationalised all large firms and banks and financial companies and applied many restrictions on their business. The subsequent Iran/Iraq war also adversely affected the economy significantly.

After the initial high growth rates, Iran's GDP growth decreased to on average 1.5 percent annually between 1978 and 1989, although between 1989 and 1991 the average annual growth rate increased by7.2 percent. In 1976 crude oil production reached 5.6 million barrels per day and it fell to 1.4 million barrels per day from 1980 to1982, but increased to 3.3 million barrels

per day after the Iran-Iraq war, but this was still below the production in 1970s. The share of oil in GDP dropped from 35% in the 1970s to 14% in the 1980s. There was also high inflation, with the CPI increasing from 1979 to 1991 by 637%.

In the 1990s the economic growth increased by 2.4% per annum from 1992 to the 1999 period. In 1998-1999, The decline in oil revenue prevented any growth from 1996 to 1997. In the late 1990s and early 2000s the annual growth rate increased to 6.5% in 1996 and the average economic growth was approximately 5% between 2000 and 2007 with a minimum of 4.5%, in 2007 the economic growth reached 6.9%. and in 2013 it reached 7.6%. The annual inflation rate was 11% in 2006 and increased to 18% in 2007. The main factor contributing to high inflation was the increase in the money supply as a result of government policy (IMF and World Bank data).

Figure 2.4: The performance of real GDP



source: World bank and IMF

According to the data from IMF database, in Iran there has been a significant link between its oil revenues and economic growth. Between 1980 and 1982 there was a significant decrease in oil revenues and also a drop in GDP. Oil revenues then increased from 1982 to 1984 and there was another decline from 1984 to 1986 and also declines in the GDP. between 1989 to 1991 there was an increase in oil revenues which helped the economy to develop. Although there was a decline in 1993 that caused the GDP significantly to decrease. In 2000 and 2002 oil prices increased from their previous lows and Iran experienced high growth. Moreover, oil revenues have had an effect on the exchange rate. oil revenue decreased in the middle of the

1990s caused by an increase in the dollar's purchasing power and this trend reversed in the late 1990s.

Before the mid 1990s, foreign trade and the foreign exchange market were controlled by the government and that caused a different relationship between oil revenue and the exchange rate. The government reduced the import demand to appreciate the currency. After a decline in oil revenues the government tightened the controls to encourage a more positive relationship between the exchange rate and foreign income.

The intervention in the foreign exchange markets caused an inefficient allocation of resources in terms of exports and the lower value of the currency resulted in buying in fewer domestic goods with oil revenue and delayed capital formation. Other aims arising from the governments' significant market controls in response to shocks was keeping inflation low which was effective in the short run, but caused more inflation in the long run mainly in an attempt to close the gap between the official and market exchange rate and mild overvaluation of the exchange rate through the multiple exchange rate system.

According to Zahedi and Azadi (2018), Money supply mis management by the central bank caused more inflation, there was a sharp rise in inflation in the 1980s which coincided with the political instability, oil revenue falls and external conflicts. Although monetary expansion helped the real money balances, there was lower inflation from 1984-5 due to oil revenue rises and in 1986 there was a significant increase in inflation due to oil price declines and the Iran-Iraq war which continued till 1989 and resulted in the collapse in real money balances. Then there was a fall in inflation and rise in real money balances afterwards which can be seen in fig 1 d and e. In 1990 deregulation of the money markets along with the currency depreciation

caused higher prices, also there was an expansion in fiscal spending which helped inflation to rise in the early 1990s.

In 1991-1992 Due to significant increases in imports and stagnation in oil revenues there was a deficit in the balance of payments which increased significantly in 1993-1994. Foreign debt started to increase and also increased the balance of payment crisis when oil revenue decreased in 1993. By 1993 foreign debt was around 30 billion dollars. Oil revenue reduction and OPEC production quotas in the following years resulted in the rescheduling of the debt to 1996. Increased output growth and imports moderately decreased inflation up until the 1993-1994 balance of payment crisis which caused shortages in imports and the depreciation in the local currency. Increased oil revenues thereafter have helped the monetary and fiscal policies to become more expansionary and also caused an increase in inflation. When the crisis started the Iranian currency lost its value significantly.

2.6- The Iranian Exchange rate:

Since 1979 the Iranian currency has depreciated significantly. Iran has experienced a variety of exchange rate regimes during this time, such as the fixed exchange rate or multiple exchange rate regimes. As in 1990 there was the official exchange rate for foreign transactions of the public sector, the competitive exchange rate for essential private imports and the floating exchange rate for other trades. The official and market exchange rates have been approximately the same from the start of 1979 but diverged soon after. Although they have reached the same rate over the years with major jumps a few times, such as when the unification of the exchange rates was tried in 2002. Overall the decreasing oil exports have had a downward effect on the currency. In the beginning of 2012 the market exchange rate depreciated by 25% and following

this the central bank depreciated the official exchange rate by 8 percent. and by the end of the year the Iranian currency depreciated significantly (Central Bank of Iran).

The Central Bank of Iran has used the official exchange rate to control inflation, with respect to foreign asset stocks and imports. One of the characteristics of this exchange rate policy is the use of a multiple currency which is using different exchange rates such as the official exchange rate for essential imports and a floating exchange rate for other imports. In 1993 Iran determined there should be a unification of the exchange rate but this was later cancelled due to high inflation and excessive foreign debt. Another effort at unification was tried in 2002 which also was not successful. The central bank tried to stabilize the market exchange rate through strict capital controls which were not successful. Iran's official exchange rate has depreciated on average 18% annually since 1989 (Zahedi 2018).

2.7- Sanctions and responses:

Iran is facing three types of sanctions: unilateral US sanctions, UN sanctions and EU sanctions. The US sanctions have faced resistance from some countries like China and Russia and also the EU in some aspects. The first sanctions imposed on Iran by the United States were in 1980 and since then further sanctions have been imposed on Iran's economy in different ways. During 1989-1991 sanctions were relaxed and tightened again in 1993, followed by the Iran-Libya sanctions from 1996 to 2001 which imposed trade and financial sanctions on investment in the energy sector. This sanction was extended to non-US companies which was opposed by the EU. During 1999 and 2000 the trade sanctions eased because of more moderate policies from Iran. However, the Iran-Libya sanctions were renewed and tightened in 2001 until 2006 in the Iran sanction Act and Libya was no longer included. The US extended and tightened

sanctions up to 2011 due to concerns over Iran's nuclear program. Due to the imposed sanctions the share of the G7 countries declined significantly in Iran's imports and the shares of China and the United Arab Emirate increased to fill the shortfall (Katzman 2021).

Iran has responded to sanctions by seeking economic opportunities from other countries. With the withdrawal of the European and Western companies from the Iranian market, Iran has been expanding opportunities for trading with other countries, mostly from Eastern Europe, such as Belarus, Hungary, and Romania among others. Iran has also created trading partners and alliances with Asian countries such as India, Japan, Singapore, and China. Recently China has become the main and largest trading partner with Iran. Since 2010, these partnerships have increased.

In addition, the Iranian authorities have been shifting to gasoline supplies, which are considered more resistant to western and European economic sanctions. An empirical study by Marinov (2005) has revealed that Iran has a policy of diversifying its international trade routes in response to the economic sanctions. The expansion of non-oil export markets is another strategy used by Iran to respond to the economic sanctions imposed by the western countries (Kaempfer 1992). Since the 1990s, Iran started focusing on establishing and developing long-term regional economic partnerships that specifically targets its oil industry (Pape 1998).

Iran is also focusing on the development of its technologies and markets as a strategy of countering economic sanctions. The strategy has helped avoid triggering sanctions, as it does not engage with foreign partners. Iran has also been attempting to persuade the non-American firms to violate the sanctions.

Over the past few years, the USA, UN, and EU have imposed several economic sanctions on Iran mostly aimed at its oil sector. The intensity of the sanctions has increased with time. However, Iran has responded by establishing various strategies.

Also, Iran's oil exports and non-oil exports shifted from the US and Western Europe to Asian economies and Iran has found a new market for its exports. In 2005 and 2006, 56 percent of Iran's oil exports were to Asian economies and 26 percent to Western Europe. UAE, Iraq, India and Japan have become the new destinations for its exports. Iran has also established free trade zones to facilitate trade with its neighbouring countries. So, US sanctions have slowed investments into the energy sector but have not stopped them. It is believed that the multinational sanctions have been more effective than unilateral US sanctions. The UN imposed sanctions on Iran in 2006 and 2007 aimed at the sensitive technologies for its nuclear program and financial assistance (IMF database).

To make the sanctions less effective Iran has shifted its trade to Russia, Asia and the GCC countries and increased its trade with these countries continuously. Also, Asia has received a large share of the imports from Iran due to a lack of European trade. Although the US has imposed more financial pressure on these countries to prevent them trading with Iran. (United Arab Emirates and Dubai). Trading with Dubai has also been one of the main paths for Iran to bypass the US sanctions. High oil revenues have helped the Iranian economy and have been the source for financing the fiscal expansion. In 2014 Iran secured a contract to supply gas to Oman (IMF database).

Iran's oil export revenue has increased from 2005 to 2008 by 45 billion dollars. The large oil revenue has led to increased inflation. However, oil revenues have helped the Iranian

government to reverse the effects of sanctions. Although sanctions caused a decline in foreign investment in the energy and manufacturing sectors, oil revenues, however, helped the government to somewhat offset this shortfall by increasing domestic investment. Moreover, the government has used oil revenues to control the exchange rate from the financial shocks after the imposed sanctions.

2.8- Events of imposed sanctions[2]:

1980: US imposes sanctions on exports from the US to Iran which were lifted after a year.

1984: US unilateral sanctions. US sanctions banned all US assistance to Iran and all weapon sales.

1987: US banned imports from Iran and caused a 1-billion-dollar loss in export revenues

1990s: Iran – Libya sanction in 1996 imposed by US.

1991: Sanctions were reduced.

1995: Sanctions imposed on US trade with Iran and also investments in Iran were imposed. Iran offered rewards for companies to invest in the oil sector. US investment in Iran's energy sector was banned and also US trade with Iran were prohibited.

1996: US tightened the sanctions targeting the oil sector and imports from the US were reduced to zero

[2] Dates collected from the Federation of American Scientists (FAS).

2000s: A number of US sanctions were imposed. However, in April 2000 the trade ban was relaxed for some imports from Iran.

2006: In December 2006 the UN imposed economic and commercial sanctions against 10 entities linked to nuclear programs and some financial assets were frozen. Also, the US extended sanctions.

2007: An embargo was imposed on Iranian arms purchases and restrictions on loans to Iran (imposed by UN). US and EU were in favour of sanctions to prevent institutions/individuals from making financial commitments to Iran.

2008 and 2010: UN sanctions were extended and new restrictions on Iranian investments were imposed.

2010 to 2012: EU sanctions along with a number of US sanctions were imposed mostly on trade with Iran and a full ban on imports which was relaxed in 2000 was again renewed. Strict bans were imposed by the US on imports from Iran. Although EU sanctions did not include Iranian oil and gas imports. Japan and south Korea imposed the same sanctions as the EU. The UN also applied an intensification of former resolutions and penalties

2011: Sanctions imposed on the Central bank of Iran and foreign banks dealing with Iran's central bank. The UK and Canada stopped doing business with the Central Bank of Iran and Iranian financial institutions. The US sanctioned foreign banks that dealt with the Central Bank of Iran unless the country reduced the oil purchases significantly, this started in 2012.

July 2012: The EU imposed sanctions targeting Iran's oil exports and by October 2012 the currency was depreciated against a basket of foreign currencies.

2013 to 2016: The removal of EU sanctions and suspension of some US sanctions. Although at the same time some sanctions were added by the US.

2015: It was agreed that sanctions should be lifted, as Iran and its negotiating partners reached a deal on Iran's nuclear future.

2016: most UN sanctions were lifted.

2018: US reinstated all sanctions against Iran

2019: US announced that will sanction whoever deals with Iran or purchase its oil.

2020: US imposed further sanctions on Iran's financial sector, targeting 18 Iranian banks and UN arms embargo expired.

2.9- The trend of the sanctions and their effects on GDP[3]:

1977-78 to 1988-89: GDP dropped by 1.5 % a year on average. In this time period Iran experienced both US sanctions and the Iran-Iraq war and these affected the economy negatively.

1989-90 to 1990-91: GDP experienced 7.2 % annual growth on average this occurred at the same time as a reduction in the sanctions imposed by US.

[3] Data collected from CBI, IMF and the World Bank

1977-78 to 1990-91: The share of aggregate consumption in GDP increased from 62% to 77%.

Oil production declined during the Iran-Iraq war and afterwards started to increase but still not as much as during the 1970s.

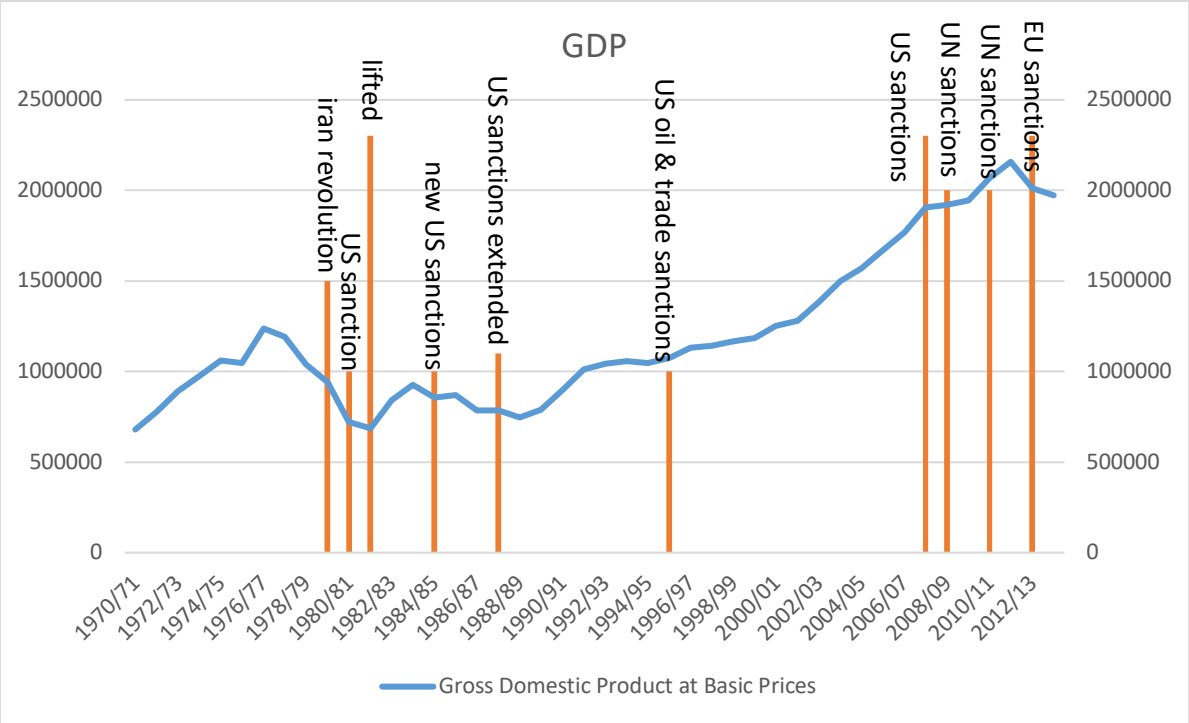
The share of oil in GDP decreased in the 80s in comparison with the 70s due to a number of reasons such as: damage to oil equipment from the war, the decision to save oil reserves, low world oil prices, and a lack of technology in the oil sector.

From 2004: An increase in Iranian GDP coincides with an increase in trade with China. Also Iran's exports increased.

From 1990, Iran started to have a close relationship with Russia: aircraft, submarines, investment in nuclear reactors (800m$), Caspian Sea oil (joint) (exploration and production).

Iran engaged in an oil swap deal with Azerbaijan, Kazakhstan, and Turkmenistan and started to trade with South Africa from 1994.

Figure2.5: GDP



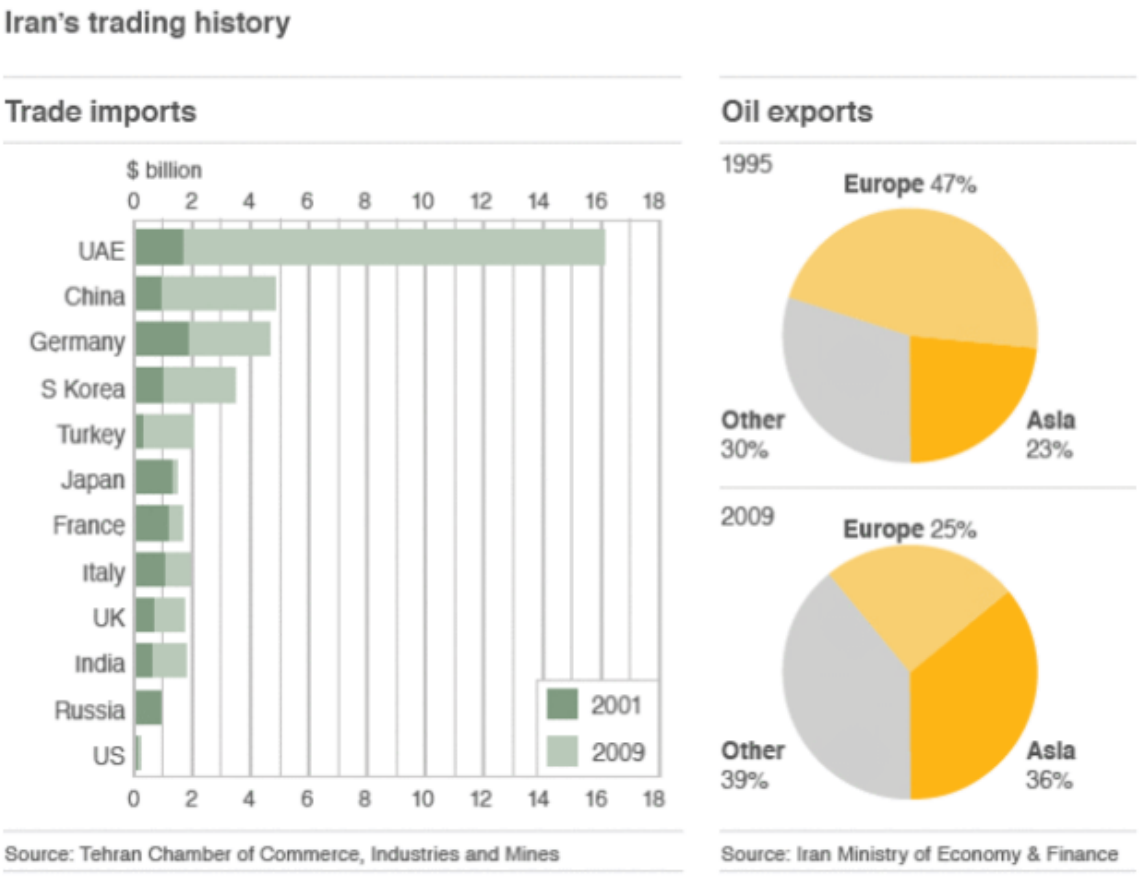
source: personal collection.

While showing a slow but steady increase in the past 30 years, Iran's oil production started to decline in 2005 due to a lack of investment in developing current and new oil and gas fields. Iran's political circumstances and its buy-back scheme have deferred international oil companies trading and investing with Iran as the world's fourth largest oil reserves.

Figure 2.6 presents the shift in Iran’s international trade. It shows Iran’s trade partners in 2001 and 2009. As is shown, UAE is the largest trade partner in 2009. China and Germany are the other main trading partners regarding imports. There is no trade between Iran and the US during these years, because of the sanctions imposed by the US on Iran. Before imposing trade sanctions, the majority of Iran’s exports were from Europe, however in 2009 the EU share of

Iran's exports had reduced from 47% to 25%. This reduction could have been caused by the UN sanctions and extended US sanctions. China in particular is now Iran's biggest trade partner, while its share was only 1% of total exports before the imposing of export sanctions on Iran.

Figure2.6: Trading History



The annual Inflation rate in Iran from the Central Bank of Iran is shown in figure 2.7. The maximum inflation rate has been experienced in 1995 at 49.4%. According to the annual inflation data, another inflation peak was in 2008 and after a reduction in 2009 inflation

increased to around 30% in 2013 and in late 2014 it was reduced to 15.6 percent. According to the IMF, Iran is one of the top 10 countries with the highest inflation rate.

Figure 2.7: Annual Inflation

Source: World Bank; World Bank Source: International Monetary Fund, International Financial Statistics and data files

The high inflation is associated with output growth negatively.

2.10- The Central bank of Iran:

The Central Bank of Iran was established in 1960 and is a government organization. The main intentions of the central bank are facilitating trade transactions, controlling the value of the

currency, balance of payment equilibrium and economic growth. Iran's banks follow the Islamic banking framework and apply an interest free framework (Zahedi et al. 2018).

Islamic banking bans interest and the interest which is banned is a fixed or predetermined return on financial transactions. this does not include the uncertain return from profits. modern Islamic banking is working based on profit sharing. And modern Islamic banking is being used in Iran. In this study interest rate is referred to the profit sharing and interest is the term that is used in Iran.

2.10.1- Monetary and Fiscal Policies:

Having a large amount of natural resources, Iran's economy has not developed as expected due to a number of different reasons such as a lack of beneficial monetary and fiscal policies due to international sanctions. For oil exporting countries such as Iran, increases in oil revenue or oil prices tend to cause fiscal policy expansions.

Iran's Government income is the sum of the oil income and taxes with oil income playing an important role in fiscal policy in Iran. Moreover, taxes do not have a significant role in government incomes. This can be determined from the oil income flow in the government budget (Amid, 1999). Oil and natural resources are the main source of revenue in Iran beside capital and financial assets and tax revenues.

Another important factor in fiscal policy is Iran's budget deficit. Iran has faced a substantial budget deficit for a long time and most of it involves borrowing from the Central bank of Iran which has also caused more inflation. Many researchers like Derakhshan, 2005, believe that fiscal indiscipline is a factor affecting the inflation rate after the revolution. Moreover, Fiscal

policies have a significant effect on GDP as noted by Rezaei 2004. One of the fiscal policies that was adopted by Iran was the rebalancing of revenues such as increasing non-distortionary taxes and lowering the oil revenue dependency.

In general, the Central Bank can adopt policies directly independent of market conditions or indirectly. Iran's direct monetary policy tools are bank interest rate control and credit limits. Indirect tools include the central bank's partnership bonds, legal deposits and special deposits from the banks held in the central bank. Liquidity is also an important factor in analysing monetary policies, as Iran has faced a high liquidity growth. The liquidity peaked at a 58% rise in 1974 and reached the minimum of 6% in 1984. On average, the liquidity increased by 28% annually from 1973 to 2006. This growth rate has been one factor that caused inflation to rise (Hadian 2008).

The money supply has experienced an increasing trend especially after 1997. One of the direct monetary tools that the Central Bank of Iran can use is through the banking profit rate which is determining the profit rate or banking facilities' expected rate of return, also minimum and maximum profit rates or investments' expected rate of return. The Central Bank is authorized to determine the bank's profits, which affects the credit markets and interest rate and these policies in turn affect economic factors such as inflation. (Hadian 2008). Iran has attempted several fiscal reforms, mainly to reduce the budget deficit which included some revenue generating measures like changes in the tax rules, expenditure savings and public enterprises. The government revenue to GDP ratio decreased by half from 1980 to 1990, following the Iran/Iraq war.

Trade liberalization has been a part of Iran's economic reforms. This has resulted in an increase in imports and exports. The policy of fixing the exchange rate while inflation rate was high, helped imports and the export of resource-based commodities increased significantly. During the 1980s the exchange rate was mostly fixed, which is the same time that there were negative shocks and this resulted in an overvalued currency (Central Bank of Iran).

Iran's financial and economic sanctions and short run external debt forced the government to withdraw the exchange rate unification. In 1995 a dual exchange rate system was proposed. One is the official exchange rate which was fixed to 1,750 Rial per US dollar for oil and gas exports and essential imports. The second one is the export exchange rate which was fixed at 3000 Rial per US dollar for non-oil exports and non-essential imports. Alongside the official rates there was the black-market exchange rate. The Central Bank of Iran kept the fixed exchange rate policy for some years (2002-2010).

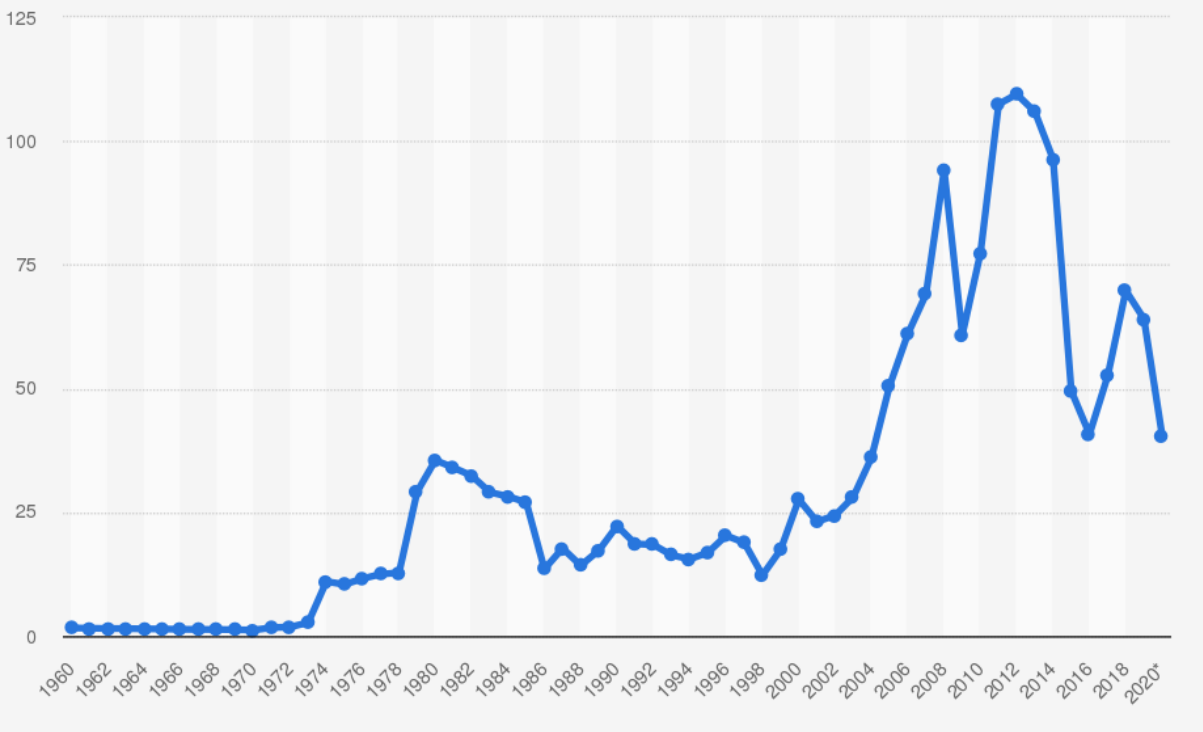
One of the Central Bank of Iran's policy goals was price stability which was not successful and over the past years average inflation in Iran has been about 20%. A lack of monetary instruments and fiscal policy dominance are some of the reasons that monetary policy has failed in Iran and the fiscal deficit has been financed by borrowing from the central bank. Government has been unable to collect taxes from some institutions and borrowed from market lenders and decreased the subsidies on energy. As a result, the money supply increased to fill the gap in the budget. Due to Islamic banking and a poor financial sector, the central bank has limited monetary instruments (Zahedi and Azadi 2018).

Some of the factors that have caused the banking system problems are fiscal dominance, corruption, institutional weakness and immorality in the system. The central bank of Iran was

established in 1960 and is a government organisation, but after the revolution it is working with an Islamic finance framework which includes the concept of non-interest-bearing instruments so predetermined payments are not allowed such as interest and this restricts the funds to a profit and loss sharing basis. After the Iran-Iraq war, Iran aimed to introduce some structural reforms that involved exchange rate unification, price liberalization and privatization. This reform was successful at first but then the economy faced stagflation due to US sanctions, foreign debts, oil price reduction as in figure 8 below and significant liquidity growth leading to inflation. Then in 1995 the exchange rate unification and price liberalization were reversed. The Central Bank of Iran determines the external debt in US dollars.

According to the economic data from CBI and IMF from 1999 to 2005 there was an expansion in the economy due to increased oil prices and less tension with Western countries, inflation dropped by a half and GDP increased. From 2005 to 2013 there was energy price reforms which were ineffective in the end. A direct cash transfer program which started in 2011, was successful initially but as the payments did not adjust with inflation it failed. After removing energy subsidies, a direct transfer cash program was stablished as replacement for energy subsidies which was around 15% of GDP. These transfers were paid directly to individuals who were in the bottom one-third of the income distribution. However, these direct cash transfers were paid to everyone due to difficulty in identifying the individuals.

Figure 3.8: OPEC crude oil price per barrel:



Source: OPEC and IMF database

Also, Corruption and poor planning caused the failure of the reforms. Financial institutions started to grow and as a result liquidity demand increased and interest rates increased and so banks faced more pressure. In 2012 sanctions were imposed on Iran which targeted the banks and the central bank of Iran helped the decline of the financial system to accelerate. In 2013 sanctions reduced the oil exports and this reduction along with a decrease in oil prices reduced oil export revenue more. In 2015 after joining Joint Comprehensive Plan of Action, which was an agreement to limit the nuclear program in exchange for lifting sanctions, inflation decreased to about 10% and the economy started to grow due to increased oil exports.

2.10.2- Five years development plans:

From 1989 to 1994, the first five-year economic plan was implemented. The main aims of the first five-year plan was to eliminate some nontariff trade limits, develop Iran's infrastructure, reduce inflation and liberalize the exchange rate system (Valadkhani 2001). During this period of time GDP growth was 7 % annually and the targeted growth was 8 percent. Moreover, imports increased from 13 billion US dollars to 31 billion US dollars. Iran was not able to repay the external debt and the government decided to reduce its imports as a result. However, despite the policy of limiting imports and also increases in non-oil exports the deficit remained high (Valadkhani 2001).

The first five-year plan was based on expansionary fiscal policies. However, after the oil price decreased the government used external borrowing and caused a significant increase in foreign debt. From 1995 to 2000 the second five-year plan was established and followed further liberalization policies as in the first plan. During these years the economy experienced gradual and slow growth, but lower than the targeted rate. the second plan also increased Iran's foreign debt.

The third five-year plan was from 2000 to 2005 and aimed at principally budget and tax reforms, greater transparency in the macroeconomy, privatization and transition from a monopoly to competitive markets. The growth during this period of time was acceptable and also increased oil prices helped government revenues, but the privatization plan was not successful (Central Bank of Iran).

The fourth five-year development plan was between 2005 and 2010. Some of the aims of this plan were increased economic growth, reduced inflation, increased non-oil exports and reduced oil export dependency and privatization. During the fourth plan the growth was not as expected and was significantly below the target growth of 8 percent. There was a reduction in inflation due to the central bank's tightened credit policy. There was also a decline in liquidity growth during the global financial crisis. From 2011 to 2016 the fifth five-year development plan was established. The fifth plan was aimed at optimising of industrial production to reduce the oil dependency.

2.11- Triadic sanctions theory:

Triadic sanctions have a distinguishing difference from other sanctions, which have a sender or senders and a receiver, the receiver is the actual target. The receiver of the sanction is not the actual target but a potential sender, so the original sender punishes the target. Considering Iran, the receiver are foreign entities investing in or trading with Iran rather than Iran. In theory, in this way the US can hurt Iran more than if it targeted it directly.

We have 3 players, leading sender (U), target (I) and third party (C). In the case of Iran, the target is Iran, sender can be the US and the third party are the foreigners who if they do trading and investing with Iran will be fined. The level of compliance Ki affects the sender payoff. $k_d = g^{-1}(\alpha_{IU} T_1)$, T_1 is the total expected gain from trade for the target and α_{IU} is the sender's trade share in the target country. α_{CI} is the target country market share in the third country and α_{CU} is the sender country market share in the third country. The α_{UC} is the third country market share in the sender country and lastly the α_{UI} is the share of target country in the sender country. The target should pay the cost of $-g(k_i)$ (Han, 2012).

$k_t = g^{-1}(\alpha_{1c} + \alpha_{1u})T_1)$

Table 2.2:

Trade Dependency Relationship Among Three Players

	U	I	C
U		α_{IU}	α_{CU}
I	α_{UI}		α_{CI}
C	α_{UC}	α_{IC}	

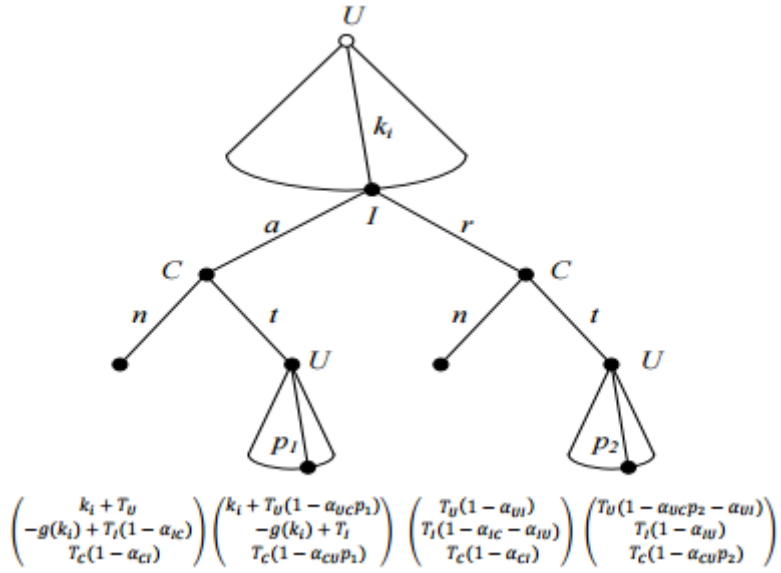
Source: Han (2012)

Considering Iran and US sanctions, the k_0 is an exogenous level of k_i, a level of compliance that the US wants from Iran. We know that previously, the dyadic sanction has not worked. Therefore, we can conclude k_d<k_0. Assuming k_d<k_0<k_t, then If the triadic sanction had worked, US could getk_0.

The maximum level of $k_i$for the US is k_d which is not good enough. So, the triadic sanction was not effective.

The minimum p_2 (punishment level p between 0 and one andp_2 p2, when I rejects $k_t$and C trades with I, U punishes C by reducing trade by $p_2 = \frac{\alpha_{IC}}{\alpha_{CU}}$). This is required so that the third party has to comply depending on the trade dependency of the third party and the sender and the target country and maximum punishment that the sender imposes depends on the level of its trade with the third party.

Figure 2.9: The Game Tree



Source: Han (2012)

In Han (2012), which studies the structure of triadic sanctions through a simple game, he has shown that economic sanctions in general make full use of triadic relationships: the US (A) threatens to restrict a third country's (C) US market access if it exports refined petroleum to Iran (B).

It is shown that countries B and C both will experience a loss in welfare vis-a-vis the pre-sanction days when C succumbs to such a threat. Such triadic sanctions are especially effective when there is not a strong trade or investment relationship between the target and the sanction sender. Even if the sender's market share of the target country market is big enough, in such a globalized market like todays, there will be another country that is willing to take the imposer's place.

Han (2012) shows that depending on the third party's economic reliance on the US or Iranian market, there are eager third parties of the sanctions like Korean and Japanese firms, and less-

eager third parties like Chinese ones. Moreover, depending on the US's dependency on the third party's firms, the level of sanction enforcement varies and all in all third parties continue their businesses with Iran and the actual effectiveness of the sanctions can be undermined. Based on anecdotal evidence of the triadic theory the US sanctions imposed on Iran are not effective. However, this theory has been examined statistically using the FE panel estimation in a few studies such as Early (2012) which indicated that sanctions effectiveness is not significant as it was expected.

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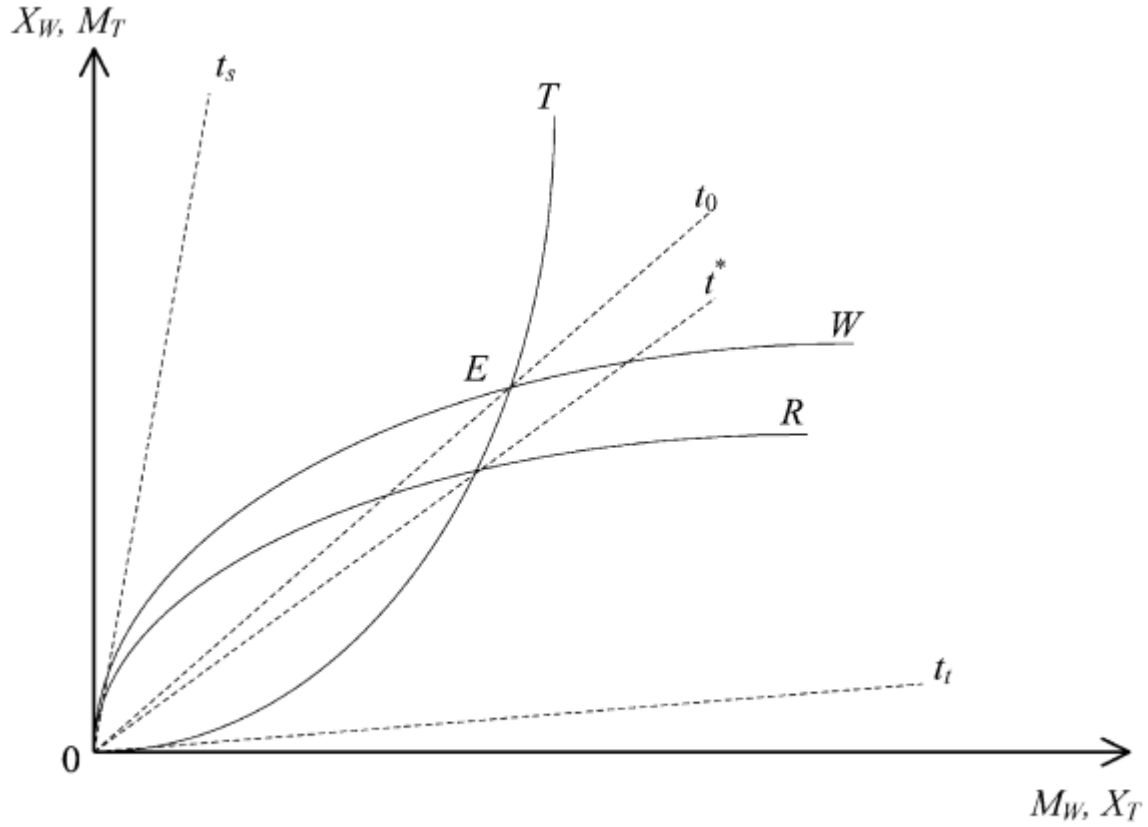
2.12- An Offer Curve Analysis:

The extent of the trade relationships between the country which imposes the sanctions and the target country determines if the target country can find alternative traders easily. Kaempfer and Lowenberg (1992, 1999) studied the effect of trade sanctions on the price of imports and exports using offer curves. These show the quantity of one product that a country exports for the quantity of another good that the country will import. Using the offer curve to see the sanction's effect can also show the welfare effect of sanctions.

Figure 2.10: Offer Curve



Source: Han (2012)

Figure 2.10 shows an offer curve equilibrium between a targeted economy for sanctions (T) and current trade partners, in this case all other economies (W). X_T is the quantity of export goods for economy T and M_T is the imports. Points on T's offer curve show the international trade equilibrium for T. The terms of trade are shown by the slope of the line from the origin to a point on the offer curve. As we move along the curve welfare increases. It is assumed that the target's export is the sender's import and the target's import is the sender's export.

X_W=M_T, M_W=X_T (2.1)

We assume that T is the only supplier of X_T. And the intersection of the two offer curves, E, is the international trade equilibrium.

Imposing multilateral sanctions on T:

Imposing multilateral sanctions cancels the trade between W and T. It forces T to move from E to an autarky situation at the origin and worsens the terms of trade from t_0 to t_t. An autarky position will also apply for W, so the terms of trade will shift to t_s. Welfare will worsen for both the target and sender.

For the sender the shift in the terms of trade tends to increase the price of their net importable goods. For the target the opposite occurs and the shift in the terms of trade reduces the price of its net exportable good. The amount the terms of trade moves depends on the curvature of the offer curve, which is a function of the price elasticity and the size of the trading countries.

Very large countries have little curvature and do not suffer from a loss of trading due to sanctions. In contrast, small countries depend a lot on trade. They are price inelastic (demand and supply) and suffer a lot from sanctions. Their offer curve has more curvature.

The economic effect of unilateral sanctions:

By imposing unilateral sanctions from a sanctioning country S, the rest of the world will have a new offer curve R. The rest of the world's offer to trade is reduced because S's offer is removed from W and elasticity is reduced, and so R has more curvature. Because of the existence of other countries to trade with, the target country does not go into an autarky

situation, but the terms of trade worsen to t*. As the number of sanctioning countries increases, we get to autarky and the terms of trade shifts to t_t.

To conclude both sender and target countries will be worse off by the imposition of sanctions. "The degree to which the sanctions impose costs on these nations depends on the number and size of the other countries willing to continue trading and on the elasticities of the trade offers of those countries." (Kaempfer and Lowenberg, 2007, p.875). Although I am not testing the specific hypotheses based on the above model, it suggests that under certain circumstances sanctions have little effect on the target's macroeconomy, so my aim is to determine if the above model is correct in suggesting sanctions are ineffective or whether this is not the case.

2.13- Conclusion:

Iran's economy transformed from an agricultural economy to industrial economy and was involved in global markets. Moreover, Iran started to engage in trade within the global market. Iran is an important member of OPEC and had been under different kinds of sanctions imposed by different countries and mostly by the US since 1979 and this has caused fluctuations in important factors of Iran's macroeconomy, including GDP and inflation. Iran has a multiple exchange rate regime, with constant depreciations being experienced by these exchange rates, which have potentially kept the Iranian economy competitive and limited the adverse effects on the economy from the sanctions.

Chapter 3: A VAR model for the Iranian economy

3.1- Introduction:

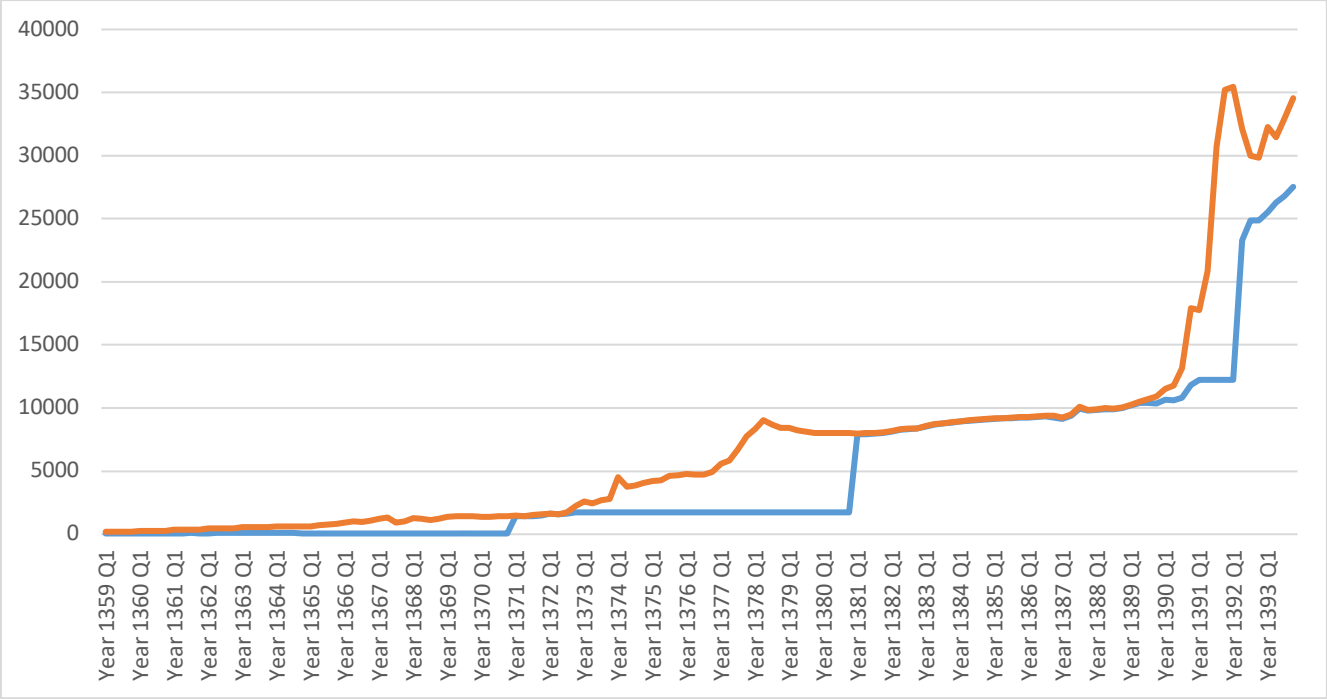
Oil and gas income play an important strategic role in the Iranian economy. Iran holds 11 percent of the world's oil reserves and is the second largest oil producer among the OPEC. Any shock to the global oil market can have a significant effect on the economy because of the high dependency of the Iranian economy on oil revenues. Since 1960 the oil production effect on the Iranian economy rose gradually and in 1974, the oil export revenue to GDP ratio increased to 47%. Although, there was a decline between 1979 and 1988 due to the revolution and Iran-Iraq war, it started to increase gradually afterwards with the average ratio of 20%. Before 1960 oil exports accounted for 50% of the total exports (Esfahani 2009) and increased gradually thereafter. The unique role of oil revenues in the structure of the government budgets and social security programs distinguishes the Iranian economy from other economies.

Even with high oil prices and revenues the government budget deficits are still a challenging issue, which can be because of the huge subsidies on the energy and food sector. Oil revenues are the main source of subsidies and are controlled by the government, so we can conclude that subsidies are affected indirectly by the oil market. The other main issue in Iran's economy is

the potential for an appreciation of the real exchange rate during the oil boom of the 1970s which lead to a trade sector contraction which is known as the Dutch disease. (Wijnbergen (1984)).

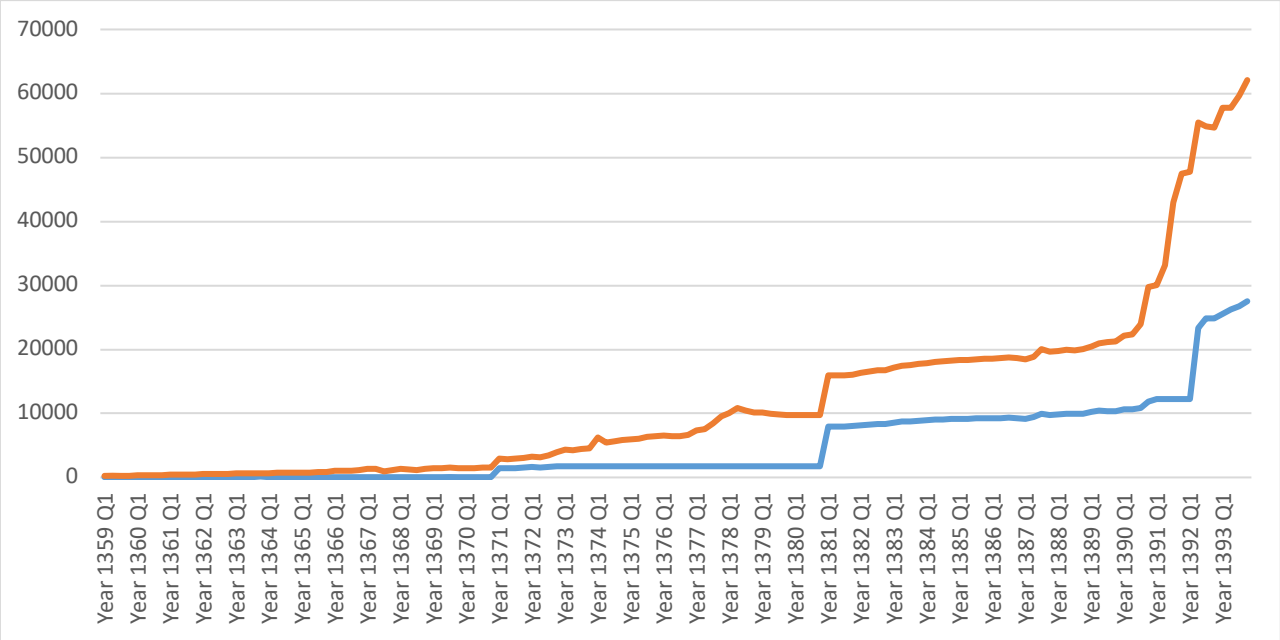
The government is the sole receiver of petro-dollars and is the largest supplier and demander of foreign exchange, so the government controls the official exchange rate. The government controls the official exchange rate and this causes a gap between the official and market exchange rates. This can be a source for rent-seeking (figure 3.1). Figure 3.2 shows the stacked line graph for the market and official exchange rate. The stacked line graph displays the trends in the data and helps to compare the trends and patterns. In fact, the lines are cumulative at each point in this kind of graph. The blue line is the official exchange rate and the orange line is the free exchange rate.

Figure 3.1: official (blue) and market (Orange) exchange rate



Source: personal collection

Figure 3.2: official (blue) and market (Orange) exchange rate



Source: personal collection

The currency weakened significantly in 2002 and 2013 after the 2012 sanctions were implemented.

Imposing sanctions on Iran has attracted considerable attention from the international community since 2003, as the United States (US), the United Nations (UN) and the European Union (EU) have imposed severe sanctions on Iran. In this chapter I try to analyse the western sanctions on Iran and their impact on Iran's economy. This study tries to answer one of the most important questions in recent years, "what are the impacts if any of western multilateral sanctions on Iran's economy?"

The aim of this analysis is to determine the interaction between the oil sector and the Iranian macroeconomy as a whole, the Iranian government's main source of income is from national resource revenues and its share of the industrial production sector is considerable. In 2011 the

international monetary fund (IMF) reported that 63% of government budget comes from oil and gas export revenues. During times of sanctions on oil exports, the country can hardly sell its oil and this can cause economic problems. This analysis does not include the interest rate as a measure of monetary policy following (Pesaran et al. 2009). This is because of the fact that domestic credit markets in Iran are controlled by the government and the rate is not market determined. Also due to Islamic banking.

3.2- Previous literature:

3.2.1- Developed countries:

The primary work on the effects of oil prices on a developed economy such as the US was initiated by Darby (1982). One of the most influential studies in this area is the work of Hamilton (1983), who used a VAR framework for the US economy and found that oil prices affect US GNP negatively and oil price shocks are important factors in explaining the US recessions from 1949 to 1973. By using the VAR model, Burbidge and Harrison (1984) investigated the impact of oil prices on five OECD countries. For industrial production, they found that the price of oil applies a sizeable influence on the U.S. and the U.K., but the responses in other countries are quite small. In another study, Gisser and Goodwin (1986) and Mork (1989) studied the effects of oil prices in developing countries. Furthermore, Mork and Olsen (1994) investigated the relationship between oil price fluctuations and GDP for seven industrialized countries, while, Lee and Ni (1995) and Ferderer (1996) also used a VAR model like most of the other papers to investigate the effects of oil prices. Federer (1996) found that oil price volatility boosts forecasts of industrial production. Hess (2000) analysed the US economy and found that oil price shocks implied lower GDP prior to the 1980s. He concluded

that oil price spikes are generally short-lived and may not have a direct effect on the US economy. He found that the oil spikes of 1973 and 1979 caused downturns in the US economy. Papapetrou (2001) was another who used the VAR approach and estimated the relationship between oil prices, stock returns, interest rates, economic activity and employment in Greece. Papapetrou's analysis showed that an oil price shock has a negative effect on employment. Increasing costs of production resulting in lower output and lower levels of employment.

Jimenez-Rodriguez and Sanchez (2004) studied the effect of oil price shocks on economic activities in seven OECD countries, Norway and the Euro area. They found that oil price increases have more impact on GDP growth rather than oil price decreases. In addition, they found that oil price increases have a negative effect on the economies of oil importing countries and mixed effects for the oil exporting countries.

In a paper about monetary policy and the transmission of oil price shocks in the US, Bachmeier (2008) utilized a VAR model and daily observations of oil prices and stock returns and found a negative relationship between oil shocks and stock returns.

Moreover, Blanchard and Gali (2010) compared current responses of inflation and output, using the SVAR and IRF analysis, to oil price shocks in a group of industrialized economies on data starting in the 1970s. Their model uses quarterly data from 1970 to 2007, and demonstrates that the main reasons for the weak responses of these economies in later years are the reduced energy/oil consumption per unit of output, more flexible labour markets, and the progress in the implementation of monetary policies.

3.2.2- Developing countries:

Most studies do not analyse the developing oil exporting countries, they are mostly about developed oil exporters and they do not include the natural resource abundant economies in their empirical analyses mostly due to a lack of data in these countries. There are a number of studies about the macroeconomic effects of resource discovery which have focused on the Dutch disease such as Krugman (1987). The Dutch disease was first experienced in the 1960s in the Netherlands after the discovery of gas. According to the Dutch disease, an exogenous increase in revenues from resources, will result in an exchange rate appreciation and a reduction in the output and employment of other goods. Along with the literatures on the resource curse hypothesis there is some literature which argues that the resource curse does not exist such as Brunnschweiler (2008). They show that resource abundance is significantly associated with growth. The recent literature on resource rich countries focuses on the political economy aspects and suggests that unexpected gains from resources can create rent-seeking that include corruption (Mauro 1995, Leite and Weidmann 1999).

The relationship between Iran's oil sector and its macroeconomy has recently been the subject of a number of empirical studies. The empirical evidence reported in the literature is based mostly on estimated VAR models and impulse response functions and variance decomposition analysis. There is an empirical consensus that negative oil shocks have larger effects than positive oil shocks on the economies of oil-exporting countries as reported by Emami and Adibpour (2012) and Mehrara (2007) which analysed the oil price relationship, and the same applies to Iran (Farzanegan and Markwardt 2009) which is in contrast to studies about developed economies e.g. Hamilton (2003).

The studies about the Iranian economy have mostly analysed the oil price shocks while I am analysing the effects of oil export changes and considering the sanctions imposed on Iran which mainly targeted the oil exports.

Mehrara, Oskoui (2007) studied the sources of macroeconomic fluctuations in oil exporting countries for four oil exporting countries: Iran, Indonesia, Kuwait, and Saudi Arabia by the VAR approach. They used data from 1970 to 2002 for oil prices, output, the exchange rate, and the consumer price index. They concluded that external shocks play an important role in explaining the fluctuations of output in Iran and Saudi Arabia, but not in Kuwait and Indonesia, so the real output is vulnerable to the changes in oil prices.

Also, Reyes-Loya and Blanco (2008) analysed the Mexican economy, focusing on the government spending, tax revenues, oil revenues and the industrial production index by using an ARIMA model for monthly data from 1990 to 2005. They found an inverse relationship between oil-related revenues and tax revenue from non-oil sources. Their results suggest a substitution effect between oil duties and tax revenue, conforming to the findings of Tijerina-Guajardo and Pagan (2003).

Mehrara (2008) examined the asymmetric effects of positive and negative oil price shocks on industrial production in 13 oil exporting countries. He studied the annual data for the period 1965-2004 and found that the negative oil revenue shocks dominate the positive shocks, and negative oil price shocks have a negative effect on the output growth. However, positive oil price shocks have less influence on the economic growth.

Jbir and Zouari- Ghorbel (2009) used the VAR approach to study the relationship between the oil prices and the Tunisian economy from 1993 to 2007. The results show that there is no direct impact of oil price shocks on economic activity, and the effects of shocks are transmitted significantly through government spending.

Chun (2010), studied oil prices and military spending, He estimated the elasticity of demand for military spending in five oil producing economies, namely Iran, Kuwait, Saudi Arabia, Venezuela, and Nigeria, using annual data from 1997 to 2007. He concluded that each of these countries show a mainly inelastic demand for military spending, and these countries expanded military spending even when they faced a reduction in oil revenues. Chun (2010) mentioned that aiming to limit defence spending through imposing sanctions to reduce the oil revenue of the oil exporter country are mostly not successful. Therefore, he disagreed with the economic sanctions on the oil exports of Iran. This is in contrast with Farzanegan (2010).

Berument et al. (2010) studied oil shock effects in selected MENA countries, this investigation included an analysis of oil price shocks in terms of the real exchange rate, inflation and output, using the VAR and IRF approaches for 16 countries for annual data from 1952 to 2004. The results show that oil price shocks have a statistically significant and positive effect on the outputs of the mostly oil exporting countries such as Algeria, Iran, Iraq, Kuwait, Libya, Oman, Qatar, Syria, and the United Arab Emirates and no significant effect on the other economies such as Bahrain, Djibouti, Egypt, Israel, Jordan, Morocco and Tunisia.

In their paper about macroeconomic dynamics in oil exporting countries, Mehrara and Moghadam (2011) used a panel VAR model. Their study indicated that in the oil exporting countries, separating the real economic sector from the oil prices is one of the critical objectives

of the government. This is what is done in some developed oil exporter countries such as Norway. Their study includes 12 OPEC members and 8 non-OPEC developing oil exporters between 1985 and 2009. They found that oil price shocks are not necessarily inflationary. They found that money is not neutral in these countries and it is the main cause of macroeconomic fluctuation. And also, oil price shocks significantly affect economic output and the money supply. They concluded that in addition to oil price shocks, domestic shocks such as to output and money can have a sizeable influence on oil prices in the world market.

Esfahani, Mohaddes and Pesaran (2012) indicate that there is a long-lasting positive impact of oil revenues on GDP for oil-exporting countries including Iran's economy. They also confirm the long run relationship between total energy consumption, GDP and the consumer price index as reported by Ghorbani et al. (2007). The Esfahani, Mohaddes and Pesaran (2012) analysis confirms Mehrara's (2008-2009) results for other oil-exporting countries.

Farzanegan and Markwardt (2009) and Emami and Adibpour (2012) focused on the relationship between government expenditure and oil prices. Both studies show the same result which is the positive effect of oil price shocks on government expenditures in Iran. they determined that oil price shocks affect output in the same direction so positive and negative oil shocks increase and decrease the output growth respectively.

In the SVAR analysis by Emami and Adibpour (2012), positive and negative oil price shocks do not affect output growth in Iran in the same way, as the short run effects are asymmetric: while negative shocks adversely affect economic performance, the impact of positive shocks is rather limited, probably due to the resource curse hypothesis.

3.2.2.1- A brief exposition of studies about Iran:

Ghorbani et al. (2007) studied the relationship between macroeconomic indexes and energy consumption in Iran. The results show that there is a long run relationship between total energy consumption, GNP and the price index. In the short run total energy consumption increases by increases in the price index and GDP, and the same relationship exists in the long run for these two factors.

Considering the Iranian economy, the Esfahani et al. (2012) results fail to find any evidence of the Dutch disease, although their study focuses on short run and temporary resources by developing a long run growth model under the assumption of a long-lasting impact of oil revenue. While Emami found results that can be explained by the resource curse and indicated that positive oil price shocks have the least effect on output, which confirms the resource curse hypothesis. And similarly, Farzanegan and Markwardt confirm the Dutch disease and resource curse. We can conclude that there is not a consensus on the existence of the Dutch disease in the Iranian economy due to the fact that there is significant depreciation in the exchange rate.

Farzanegan and Markwardt (2009) have studied the effects of oil price shocks on the Iranian economy, by analysing the relationship between oil price changes and macroeconomic variables in Iran using a VAR model. The results are in contrast to the results for developed economies, for example Hamilton (2003) and Jimenez-Rodriguez and Sanchez (2004) as positive oil shocks have a larger impact on GDP than negative shocks. In theory the Iranian

economy is much more vulnerable to the negative oil price shocks than positive shocks, due to its dependence on oil revenue.

The asymmetric effects of oil price shocks, both positive and negative shocks to oil prices have inflationary effects on the economy. The increase in oil prices however has a positive effect on industrial output. The impulse response functions in this study show that positive oil price changes have a significant and positive effect on inflation, industry output and real imports. The negative oil price shocks have a significant and negative effect on industry output, real effective exchange rate and real imports.

The Esfahani, Mohaddes and Pesaran (2009) paper examined the relationship between oil exports and the Iranian economy and developed a long run growth model for a major oil-exporting economy while assuming the lasting impact of oil revenues. The study's findings are in contrast to the evidence of Dutch disease which focuses on short run and temporary resources.

They found that in the long run, real output is affected by oil exports and foreign output. They also show that the Iranian economy adjusts quite quickly to the shocks in foreign output and oil exports, which could be due to the underdeveloped nature of Iran's financial markets. They report a significant negative long run relationship between inflation and GDP and they take it as evidence of the inefficiency of the Iranian economy.

Emami and Adibpour (2012) paper on oil income shocks and economic growth in Iran investigates the relationship between oil revenue shocks and output growth in Iran for the 1959-

2008 period. They attempt to find how output growth, government expenditure, the money supply and the real exchange rate respond to oil revenue shocks in Iran via an SVAR model.

Their results show that the oil revenue shocks significantly affect output growth asymmetrically in the same direction. Positive and negative oil revenue shocks increase and decrease output respectively, and the negative shocks have a larger effect than positive shocks. This can be explained by the resource curse. The research records that by increasing oil revenues the output growth slow down due to the resource curse and volatility in public balances.

Positive oil shocks have a positive effect on government expenditure and the money supply while negative shocks have a negative effect, a pattern which indicates the high dependence of these two elements on oil revenue shocks. The result agrees with Mahara (2008), Mahrara (2009) for some oil-exporting countries.

Positive oil price shocks have the least significant effect on output, which confirms the resource curse hypothesis. These results suggest that government expenditure and money supply and therefore the fiscal and monetary policies have a high dependence on oil revenue shocks that are determined exogenously. In addition, positive oil shocks are the most important factor for the real exchange rate, which conforms to Farzanegan and Markwardt's (2009) results.

Farzanegan (2010) studied the impact of oil revenue shocks on government spending in Iran. He estimated a model to examine the dynamic effects of oil revenue shocks on Iran's government expenditure. The results show that military and security spending is significantly affected by oil price changes while social expenditures has no significant reaction.

3.3- Sanctions:

Initial US sanctions were imposed in 1980 on exports from the US to Iran and were lifted after one year. Again, another set of sanctions was imposed in 1984 by the US In 1987 when the US banned imports from Iran and caused a 1-billion-dollar loss in export revenues (Emami 2012). Even though subsequently in 1991 the sanctions were lightened. A few years later sanctions imposed by the US were tightened. In 1995 Iran offered rewards for companies to invest in the oil sector.

The UN also imposed some sanctions on Iran. There were four series of sanctions imposed by the United Nations. UN sanctions started in 2006 and in 2007 an embargo was imposed on Iranian arms purchases and restrictions on loans to Iran. In 2008 and 2010 the UN sanctions were extended and new restrictions on Iranian investments were imposed. In 2012 the EU imposed sanctions.

Because of the sanctions, Iran tried to find new trade partners and also to reduce its dependency on oil as an oil-based economy and so Iran started to negotiate to lift the sanctions after 2014 and an agreement was finally reached in 2015. Some believe that sanctions are not that effective, as It is believed that in the long run the sanctions force the target country to find new trade partners, so there arises the question of whether the sanctions affected the economy or not and if they had, to what extent sanctions affected the economy.

3.4- The Theory behind Iran's sanctions:

Since the 1990s, sanctions have become a common tool for the politicians, especially in the US. Maloney (2010) and Leoffler (2009) believe that financial sanctions have hurt North Korea

and Iran by increasing the price of imports. However, financial sanctions were not acting as a privilege at the bargaining table. Kahn (2006) believes that for North Korean sanctions, China's fuel oil was the only factor that has been effective.

Many studies have suggested that sanctions are not effective. Hufbauer, Schott and Elliott (2007) found that only 34% of sanctions were partially successful and reported that sanctions often do not work, although, Pape (1997) reported 5% success. Contrary to these findings, Drezner (2003) suggests that selection bias is a problem in these studies, as game theory indicates sanctions to be more efficient at the threat level than when they are imposed.

US sanction on imports from Iran in 1987 did not significantly affect Iran's exports and they reached 2.6 barrels per day in the 1990s. We can conclude that the lack of multilateral sanctions was not a success in preventing oil exports and Iran easily sold its oil to other countries. Therefore, the country continued to rely on the oil revenue. Also, in 1996 the Iran Libya Act which expanded sanctions to non-US companies was not successful for the same reasons as before and European and Asian companies continued their trade with Iran. UN sanctions were imposed between 2006 and 2010 and focused on inhibiting the nuclear program rather than undermining the economy.

The IMF reported that oil sanctions on Iran could raise oil prices by 30%, so analysts believed that imposing oil sanctions on Iran would not be successful (e.g. Van de Graaf (2013)). However, after imposing oil sanctions in 2012, oil prices remained stable in 2012 and 2013. Iran's increasing trade relations with China have kept its imports as well as its Gross Domestic Product (GDP) rising. China's share of exports to Iran recently equalled US exports to Iran before the revolution

In 2012, Iran's banks were expelled from the SWIFT banking transaction system and were isolated from the international banking system. In addition, assets worth tens of billions of dollars were frozen. As major Western foreign investments slowed, it was primarily the private sector that suffered. However, the U.N. Conference on Trade and Development estimated that direct foreign investment in Iran is increasing, funded primarily by the Chinese, Russian and Turkish companies.

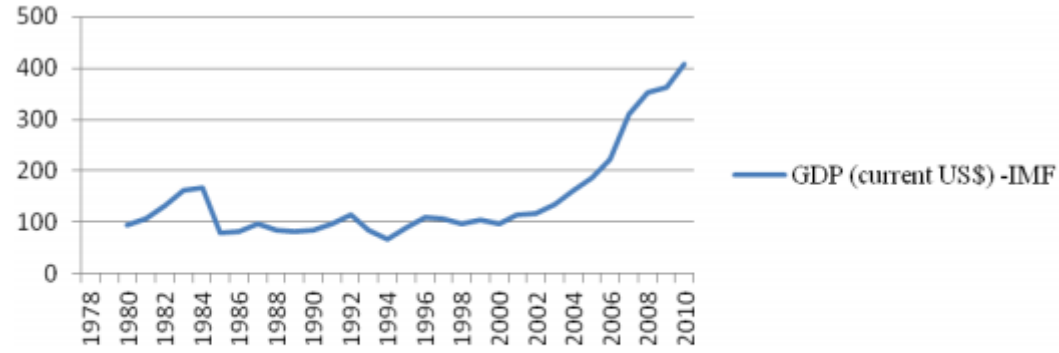
While Iran holds the fourth largest oil reserves worldwide, its oil production was hurt because the oil exports were capped and prices fell. Furthermore, in 2012 and 2013, Iran's GDP contracted and inflation increased in 2013. The government controls large segments of the economy and corruption is also high in Iran. It should be noted however that the government managed to keep the overall poverty rate in Iran below one percent, which is a remarkable achievement under the given circumstances.

Iran made a deal with the US in 2013 and 2015 so that the sanctions were dropped. The deal was that Iran moderated its nuclear program so that Iran could not produce nuclear weapons but it would be allowed to have enough uranium for the energy needs of the country. Even before a deal had been reached, Tehran had managed to bypass the sanctions in some areas, such as by laundering cash through Dubai. The other way was that Iranians arrived in Dubai with suitcases full of cash and converted it into U.S. dollars in order to enter the international financial markets. Iran's trade partners such as Russia, China, and Turkey have a significant interest in ending sanctions so that they can expand their trade with Iran (Feiler 2015).

China has become a key trade partner for Iran, enabling it to circumvent sanctions. Since the International Sanctions, Iran's GDP has increased, this can relate to increases in global oil

prices and new trade partners. Iran ‘s GDP could be defined as a reflection of its oil revenues (Abolhassan Banisadr 2010). The IMF (2011) reported that “the rebounding in international oil prices benefits Iran.” In other words, increasing the world oil prices have reduced the impact of the sanctions on Iran’s economy for some years. However, this reason may not be true after imposing sanctions on the oil sector in 2012.

Figure 3.3: GDP in US Dollars



Data extracted from the International Monetary Fund (IMF) data bank.

Reviewing the theory of sanctions, some studies suggest that sanctions are a successful way to reach the target while others focus on the ineffectiveness of economic sanctions due to the demands of the sender being hard to meet, and consequently claim that economic sanctions fail as a foreign policy tool (Kaempfer and Lowenberg 1988, 1998; George 1991; Nossal 1994; Morgan and Schwebach 1997; Drury 1998; Hufbauer et al. 2008). For example, in a recent New York Times article, Krauss (August 12, 2014) mentioned that Iran is decreasing the effect of sanctions and increasing its trade value, by increasing the oil exports to China and the Asian Market.

The Iranian government has taken every possible action to neutralize the sanctions, such as offering trade concessions to other countries that are willing to do business with Iran. Oil has played an important role. The high price of oil has been beneficial for Iran since 2002. The high oil revenue has led to economic growth. Also, high oil revenue has helped the government to stabilize the exchange rate.

The major impact of sanctions on Iran's exports and imports has been changing trading partners and the use of re-export strategies for imports and exports. Iran's efforts to compensate for the sanctions led to an increase in trade with Turkey and the GCC countries. So, Iran found substitutes for European and US companies that are unable or not willing to trade with Iran. Also, Dubai let the banned companies' trade with Iran indirectly (Katzman 2013). Although these partnerships were restricted after 2008 with US pressure. But smuggling has been increased. Iran also decided the use of a bartering system to export oil to some countries because of the sanctions on the SWIFT system and substitution of gold for the Dollar (Katzman 2013).

3.5- Data and Methodology:

The vector autoregression model (VAR) is one of the most simple, successful and flexible approaches for the analysis of multivariate time series. Enders (1995) believes the VAR model is a useful approach to studying endogenous variables and has proven to be useful for studying the dynamic relationship between multiple variables.

The VAR model is used for policy analysis and structural inference, along with data description and forecasting. In the VAR approach all variables are considered as endogenous. One of the

advantages of the VAR model is the ability to present the Granger causality test which demonstrates the direction of the variables' causality. I have used this approach to examine whether my variables can have significant impacts on each other. One of the other advantages of the VAR model which is practical for my research is that it does not impose restrictions. The imposed sanctions on the oil sector represents a shock to the oil sector in the VAR models of the Iranian economy (Farzanegan, 2011). I have examined whether the oil revenue shocks affect the other key macroeconomic variables. The VAR approach can be used to determine the dynamic relationship between these variables.

The vector autoregressive approach is one of the most useful models to describe the dynamic behaviour of the economy and also the most successful model. The other advantages of VAR model to other models is that It is also flexible and easy to use and does not make assumptions about the endogeneity of the variables, as all are treated as being endogenous. In addition, I am using an unrestricted VAR, as I aim to determine the overall effects of the sanctions on the economic variables, rather than impose specific restrictions. The VAR model is used in this section to analysis the effect of important macroeconomic indicators on the Iranian economy and to investigate the effect of shocks on the economy. In addition to the impulse response functions, I have also used variance decomposition analysis to demonstrate the contribution of relevant variables to explaining the fluctuations in macroeconomic variables.

In this research I have used the most important macroeconomic variables for an oil exporting country such as oil exports, GDP, inflation and imports. In addition, I have added the budget deficit to my variables which can affect inflation and output. Jafari et al (2006) found a negative relationship between budget deficits and economic growth in the long run. However, in the

short-term the government may run a deficit to gain some goals for example, to fund public investment. Also, I have investigated the exchange rate which is one of the most crucial macroeconomic elements. It effects the current and future economic development. The exchange rate affects international trade, capital flows and production and consumption. An unstable exchange rate will raise uncertainty and the risks of the domestic and foreign investments, and decrease social welfare (Davis 2005). In addition, studies examining the relationship between the exchange rate and the economic sanctions are rare. The other contribution is that I have extended the data in my research due to the fact that the economic sanctions imposed on Iran are changing overtime and has been continued for quite a long period of time.

Kaempfer and Lowenberg (2007) determined that the long-run and short-run impact of sanctions are different on both foreign and domestic investment, this is because of a rise in the rate of return to investment after sanctions imposed. However, eventually there will be more production costs and less profits and in the long run the target economy adjusts to a new equilibrium.

Mostly the sanctions have been tightened. However, there have been some periods when sanctions were relaxed. These changes can have different effects on the macroeconomy. In addition, the longer the period of sanctions the more the targeted country can find different ways to adjust, so extended data helps to get a better conclusion about the impact of sanctions and whether they are efficient or not. Although the imposed sanctions are mostly from the US, the countries imposing sanctions have changed over time. This is important because the trade

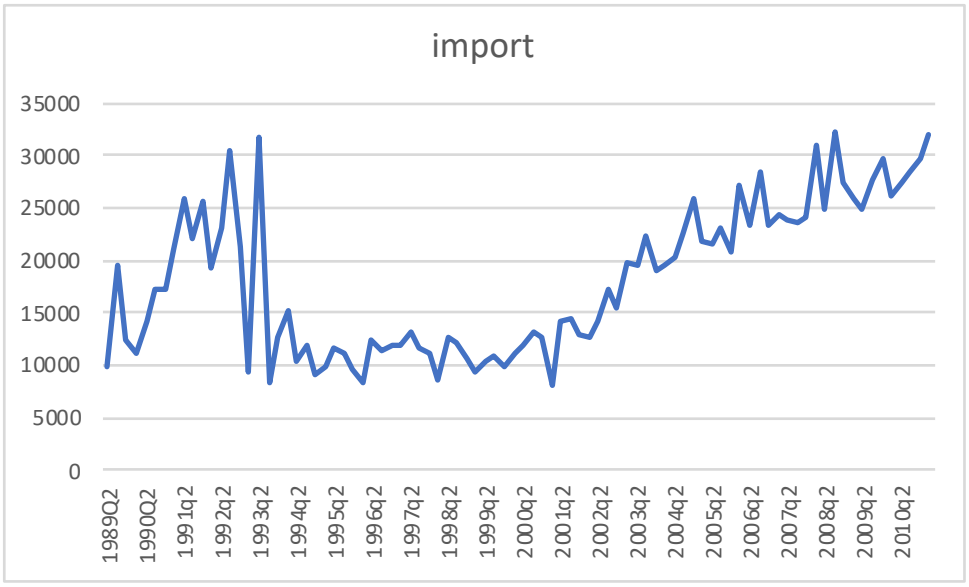
relations between countries affect the macroeconomy and exports and imports. In the long run we have more flexibility and more adjustability with a longer database.

3.5.1- Data:

In this analysis I use seven macroeconomic variables. My data set contains quarterly observations on Iran from 1991Q3 to 2011Q1 (Appendix A) which is the time period that all the variables data were available.

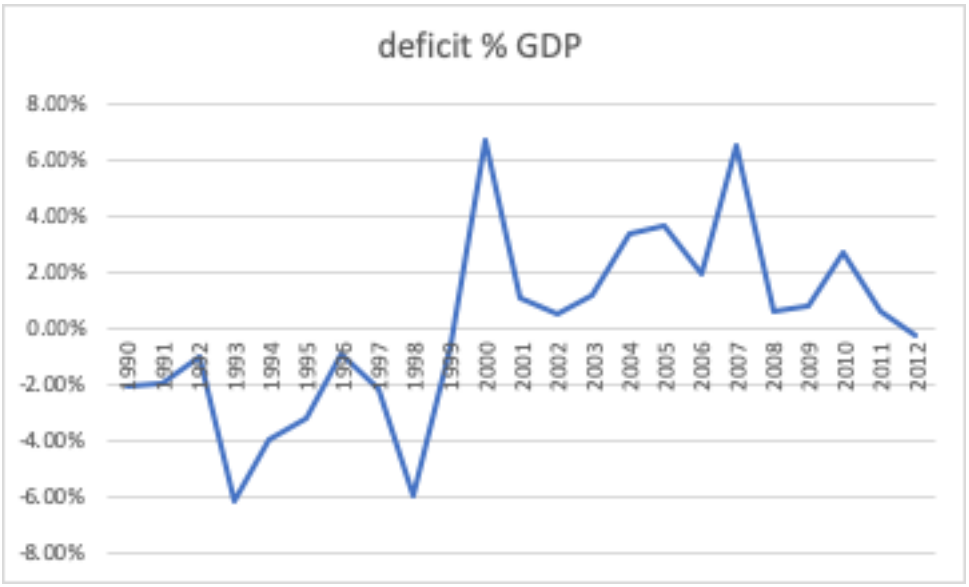
The variables included are real GDP growth, the inflation, the real effective exchange rate (REER) from the IMF, ratio of imports to GDP, oil exports (volume) and the Budget Deficit. The other variable used are oil prices which are in US dollars. All variables are in natural logarithms and I am using seasonally adjusted data as obtained from the different sources. A mixture of financial and fundamental macroeconomic variables shows a bigger picture of effects on the different factors on the economy. The most important macroeconomy variables are shown in graphs in the second chapter. Moreover, import and budget deficit to GDP ratio is presented in figures below. Iran import reached a peak in 2011 and its lowest amount has been in 1989. The ratio of Budget deficit to GDP has been around 5 percent over the several past years and it is believed that budget deficits is significantly due to large amount of government subsidies on fuel and food.

Figure 3.4: import



source: personal collection

Figure 3.5: Budget deficit in percentage of GDP



source: personal collection

Real gross domestic product is extracted from the Central Bank of Iran (CBI) online database, quarterly observations are available from 1988Q2. The real effective exchange rate based on the Consumer Price Index (CPI) is from the International Monetary Fund (IMF). Since the 1979 revolution the Iranian Rial has depreciated significantly against the US Dollar under a variety of exchange rate regimes from a fixed rate to multiple rates and back to a unified pegged managed rate. It has depreciated from 70 Rials per US Dollar in 1979 to 9170 Rials per US dollar in 2006.

As is shown in the previous Figures for the free rate or black-market rate and the official exchange rate over the period 1980Q2 to 2014Q1, which are both reported by the Central Bank of Iran, the two rates are at a par at the start of the revolution but depart soon thereafter. In this chapter we are using the official real effective exchange rate which is extracted from the IMF database and it is a good factor to look at the general performance of the exchange rate. They have however been brought into line which can be associated with the successful unification of the exchange rate in 2002. In 2002 the government unified the official exchange to a new rate very close to the black-market exchange rate. The main reason to unify the official exchange rates is to reduce the black-market premium, rent-seeking activities and social corruption, and also to decrease the administrative cost of the multiple exchange rate system, so as to have market determined exchange rates and also to assist non-oil exports.

I obtained the Consumer Price Index and import data from the CBI online database which are available from 1990Q2. Quarterly oil exports (thousand barrels per day) are available 1978Q2 from the CBI. The oil price data is the quarterly average of the monthly data from the IMF

which is the simple average of three spot prices; Dated Brent, West Texas Intermediate, and the Dubai Fateh.

3.5.2- Methodology:

I have used an unrestricted vector autoregression model (VAR) to investigate the response of macroeconomic variables to innovations. The VAR model provides a multivariate framework where changes in a particular variable are related to changes in its own lags and to changes in other variables and their lags. The VAR treats all variables as jointly endogenous and does not impose a prior restriction on the structural relationships. Once the VAR has been estimated the relative importance of an individual market in generating variations in its own value and in the value of other markets can be assessed by variance decomposition. The dynamic response of the macroeconomic variables to innovations in a particular variable or market can also be obtained from the Impulse Response Function (IRF). The IRF allows us to examine the dynamic effects of oil price shocks on the Iranian macroeconomic variables.

The unrestricted vector autoregressive model is presented as:

$$y_t = c + \sum_{i=1}^{p} A_i y_{t-i} + \varepsilon_t \qquad (3.1)$$

Where c is the intercept vector of the VAR, A_i is the matrix of autoregressive coefficients (K x K) and ε_t is the white noise process. y_t is vector of K observed variables

I have used the real exchange rate, real output growth, inflation and oil export and oil prices following Pesaran (2009). In addition, imports are used in the study by Farzanegan (2007) which analysed the oil price shocks. I have included the budget deficit to see how it is affected

and also it shows the ability of the government to finance its spending while sanctions are imposed.

According to the monetarist view, budget deficits can lead to inflation (Hamburger and Zwick (1981)). In the monetarist models, changes in the inflation rate closely depend on changes in the money supply. Generally, the budget deficit does not cause inflationary pressures, but rather affects the price level through the impact on money aggregates and public expectations, which causes movements in prices.

It is important for policy makers to know the direction of causality between the variables so that they can decide on the most relevant policies. In addition, most of the studies on the Iranian economy do not examine structural breaks. Investigating the relationship between oil exports and economic growth is important for economic welfare. Many empirical studies on different countries have indicated the relationship between oil exports and economic growth by using the Granger causality test. Some of them determined the causality between exports and growth (Thornton 1996), and some others believe that there is no Granger causality between them (Bahmani-Oskooee 1993).

Assuming the exchange rate does not Granger cause the oil exports, shows that exchange rate movements do not affect the exports. Assuming oil exports Granger cause GDP, indicates that the country is vulnerable to external shocks, specifically a reduction in oil exports. As expected form the previous literatures, the results determined that oil exports Granger caused the real exchange rate and the exchange rate caused GDP. This indicates that the real exchange rate is an important factor in increasing the economic growth of Iran. In addition, if the oil exports do

not Granger cause inflation, this could be because of Islamic banking and lack of an interest rate.

As a first step I have checked the time series properties of the variables in order to determine the appropriate specification for the VAR estimation. The variables are first differenced. The order of integration for each variable is determined using the Augmented Dickey-Fuller (1979) test. The results of this test are reported in table 5. This test indicates that the variables expressed in logs are non-stationary. When all variables are first differenced we find evidence that all variables are stationary. So the variables of the model follow I (1) processes (Appendix C). And the optimal lag length is 4. The selected lag length is based on same criteria which are shown in table 1. The first differenced variables indicate the percentage change or the growth of the variable, as an example, the first differenced (logged) GDP determines economic growth, the first differenced Deficit can be interpreted as the growth in the deficit and government debt percentage. Import changes indicate an outflow of funds from the country. CPI changes are defined as inflation. And changes in the exchange rate determine the appreciation or depreciation of the currency.

3.5.2.1- Order selection:

To determine the lag order in the VAR model I use the Akaike Information Criterion (AIC). AIC selects the lag order 4 whilst SBC selects the lag order 1. According to different criteria and autocorrelation test, the optimal lag length is 4.

Unit root test

To make a sensible interpretation of the long run relationships and to make sure that we do not work with a mixture of *I (1) and I (2)* variables, the unit root properties should be considered. For this purpose, the standard Dickey-Fuller test is used.

Stationarity test:

Table 2.11 reports the Dickey-Fuller test for the stationarity of each variable. The test does not reject the null hypothesis of a unit root. After first differencing each series it rejects the null hypothesis of nonstationary. According to the Dickey-Fuller test all variables have a unit root in levels and are stationary after first differencing. I chose the model with a trend.

Table 3.1: Dickey-Fuller test

variables	level	First difference
CPI	-2.74	-3.86
Exchange rate	-2.42	-8.91
GDP	-3.29	-8.11
Import	-1.41	-12.68
Oil export	-0.76	-7.56
Oil price	-1.18	-4.80
Deficit	-1.62	-4.77

3.5.2.2- Granger Causality Tests:

According to Granger causality, if X_1 Granger causes X_2, then past values of X_1 should contain information that helps predict X_2 above and beyond the information contained in past values of X_2 alone. Its mathematical formulation is based on linear regression modelling of stochastic processes (Granger 1969).

Considering a bivariate linear autoregressive model of two variables $X1$and $X2$:

$$X_1(t) = \sum_{j=1}^{p} A_{11,j} X_1\,(t-j) + \sum_{j=1}^{p} A_{12,j} X_2\,(t-j) + E1\,(t) \qquad (3.2)$$

$$X_2\,(t) = \sum_{j=1}^{p} A_{21,j} X_1\,(t-j) + \sum_{j=1}^{p} A_{22,j} X_2\,(t-j) + E2\,(t) \qquad (3.3)$$

Where p is the maximum number of lagged observations, the matrix A contains the coefficients of the model, and $E1$ and $E2$ are residuals.

If the variance of $E1$ (or $E2$) is reduced by the inclusion of the $X2$ (or $X1$) in the first (or second) equation, then it is said that $X2$ (or $X1$) Granger causes $X1$(or $X2$) (Pesaran et al. 2012). In other words, $X2$ causes $X1$ if the coefficients in $A_{12}$are jointly significantly different from zero, which can be tested by an F-test of the null hypothesis that $A_{12} = 0$.

As we can see from the Granger causality test results, we have evidence of Granger causality from GDP and oil exports to the exchange rate, but not vice versa. Moreover, GDP and the exchange rate Granger cause imports (Table 3.3). Oil exports only appear to Granger cause the exchange rate, suggesting that sanctions have had little effect on the Iranian economy, with the exchange rate acting as a form of buffer.

Table 3.3: VAR Granger Causality

Exogeneity Wald Tests

	Dependent variable					
	Inflation	**DEFICIT**	**Exchange rate**	**GDP**	**IMPORT**	**OIL EXPORT**
Inflation		0.83	0.28	0.95	0.37	0.29
DEFICIT	0.82		0.98	0.69	0.77	0.64
EXCHANGE RATE	0.55	0.92		0.11	0.03	0.09
GDP	0.55	0.96	0.04		0.00	0.06
IMPORT	0.75	0.95	0.53	0.19		0.15
OIL EXPORT	0.92	0.96	0.00	0.96	0.12	
All	0.94	0.99	0.01	0.36	0.00	0.18

Table 3.4: autocorrelation results

VAR Residual Serial Correlation LM Tests

Lags	LM-Stat	Prob
1	47.40	0.09
2	30.08	0.74
3	38.74	0.34

4	33.87	0.57

VAR Model and Toda and Yamamoto (1998) approach:

In this section the VAR model in levels and the Toda Yamamoto (1998) causality test is estimated. I am testing the long run causal relationship between the variables based on the Granger causality test proposed by Toda and Yamamoto (1995). Toda and Yamamoto (1995) indicated that the power of unit roots and cointegration tests are low in comparison with the hypothesis of stationarity. The variables are integrated of order 1 according to the unit root test and The VAR model in levels is estimated with the lag length of 1. This approach provides testing for causality between integrated variables (Mehrara 2007). The Toda Yamamoto (1998) model is as follow:

$$Y = \alpha_y + \sum_{i=1}^{k+d} \theta_{yi} X_{t-I} + \sum_{i=1}^{k+d} \emptyset_{yi} Y_{t-i} + \varepsilon_{yt}$$

$$X = \alpha_x + \sum_{i=1}^{k+d} \theta_{xi} X_{t-I} + \sum_{i=1}^{k+d} \emptyset_{xi} Y_{t-i} + \varepsilon_{xt}$$

My dependent and independent variables are the vector of n by 1. d is the maximum order of integration of the variables. k is the optimal lag order. The error term is white noise with zero mean. X does not granger cause Y if $\theta_{yi} = 0$ and Y does not granger cause X if $\emptyset_{xi} = 0$. I am focusing testing on the GDP, Exchange Rate and Oil Exports according to the previous results, due to the importance of these factors on Iran's Economy and also imposed sanctions. According to the results the oil exports Granger cause the exchange rate and not the GDP.

Table 3.5:

Hypothesis	**Test statistics**	**P-value**
GDP does not Granger cause the Exchange Rate	7.44	0.01
Exchange Rate does not Granger cause GDP	9.85	0.00
Exchange Rate does not Granger cause Oil Exports	1.87	0.42
Oil Export does not Granger cause the Exchange Rate	7.66	0.00

3.6- Impulse response functions:

Impulse response functions determine the behaviour of the variable in reaction to a shock in a period of time. So, the generalized impulse response function is being used, to avoid the problem of ordering of the variables.

Considering equation (3.2) as $A(l)y_t = \varepsilon_t$ (3.6)

where L is the lag and define as $Ly_t = y_{t-1}$ (3.7)

and $A(L) = I_k - A_1L - \cdots - A_PL^P$ is a matrix polynomial (3.8)

in this framework the impulse response function sets one factor of ε_t to one and all other factors to zero and determines the response of y_t to this impulse.

The middle line in the figures represents the impulse response function while the bands are for the confidence intervals. In this regard, when the horizontal line falls into the confidence interval, then the null hypothesis that there is no effect on the macroeconomic variables, i.e. they are not significantly different to zero, cannot be rejected.

The ordering of variables are according Farzanegan (2007) and budget deficit is added before inflation due to being more exogenous and affecting the inflation and is as follows: oil export, GDP, budget deficit, inflation, exchange rate and import.

Figure 3.6 Shows the Impulse response functions based on the one standard deviation shock to changes in the macroeconomic variables. The response of the exchange rate to oil export shocks are positive and significant in the first 3 periods and after that duration the response is negative and not significantly different from zero. However, it is significantly negative and reaches its minimum in just one period. It goes back to its initial level at the end of the period. This could be a sign of Dutch disease in the short run, which shows the reduction of competitiveness in the tradeable sector of the economy. Although, an insignificant exchange rate is against the expectations of the Dutch Disease theory. Moreover, a significant depreciation in the Iranian exchange rate is in contrast to the Dutch disease. In addition, according to the literature the wrong economic policies are the reasons for the appearance of symptoms of the Dutch disease during the Ahmadinejad presidency. Also, an increase in the exchange rate is accompanied with an increase in output which is in contrast with the resource curse viewpoint.

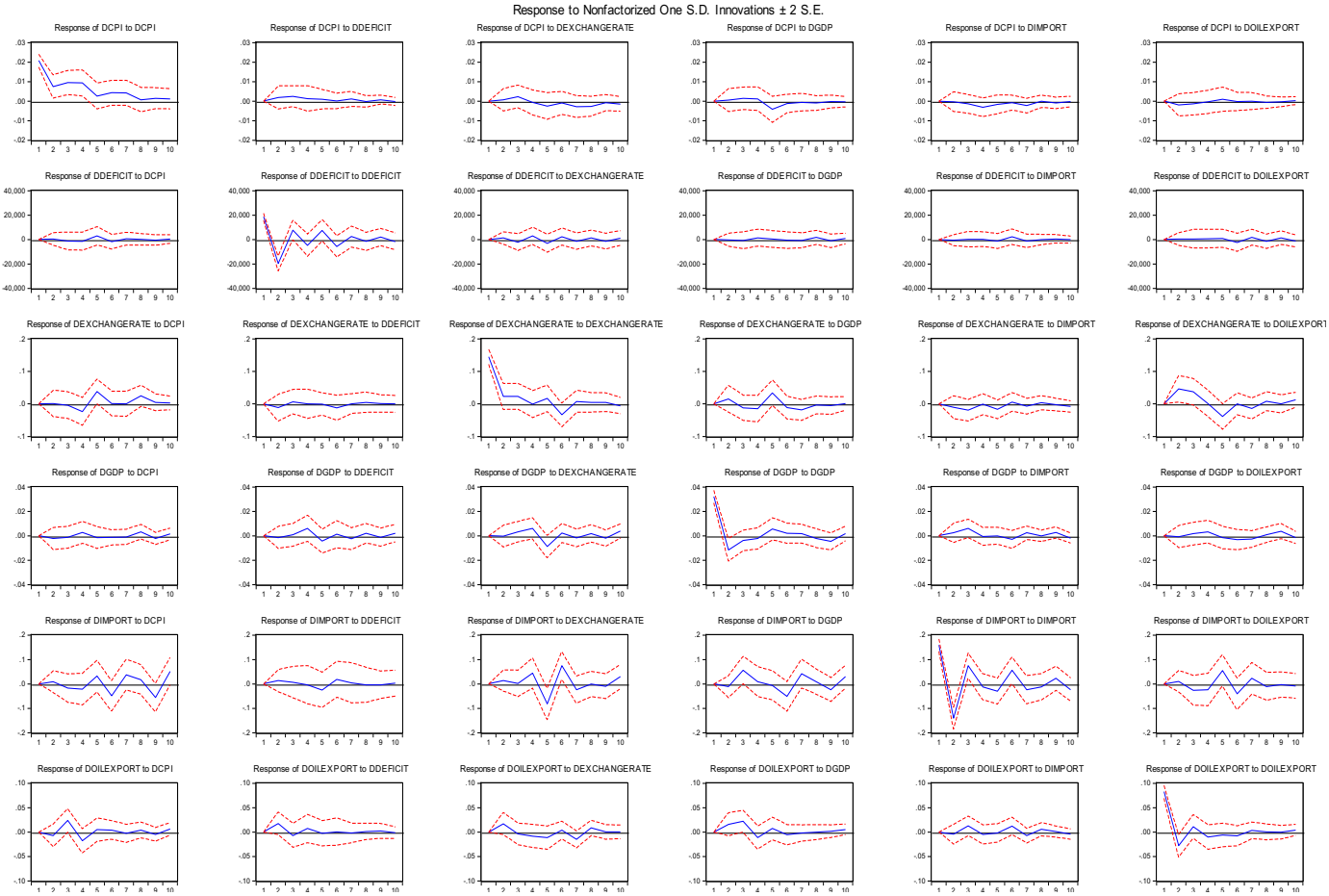
Responses of the CPI to oil export shocks are insignificant which indicates that oil export shocks do not have a significant effect on long run inflation. The sanctions on oil exports do not have a significant effect on the government budget. The effect of the oil exports on the imports is also insignificant, but significantly positive in period 5.

Responses of the deficit, imports and GDP to changes in CPI are also insignificant. Looking at the exchange rate response to a CPI shock shows an insignificant effect with a one period positively significant effect in the fifth period. The CPI affects oil exports significantly and

positively in the third period and is insignificant for the rest of the periods. Also, other variables insignificantly respond to the deficit. Imports and deficit also have an insignificant effect on the other factors.

The response of CPI is insignificant to both GDP and exchange rate shocks. Although the exchange rate and GDP responses to each other are significant in a period. The response of oil exports to GDP is positive initially and goes back to its initial level in the long run. There are fluctuations in response of imports to exchange rate and GDP shocks.

Figure 3.6: Impulse response function



3.7- Variance decomposition:

The impulse response functions demonstrate the qualitative response of the variables to shocks (Farzanegan and Markwardt (2007)). Impulse response functions can show the interaction between variables and their responses to economic shocks. Variance decomposition shows how many unforeseen changes or variations of the variables in the model are explained by different shocks. Variance decomposition assess shocks behaviour and determine the importance of shocks to describe the variables fluctuations.

Table 3.6 illustrates the variance decomposition of the VAR model. Cholesky Ordering: OILEXPORT, GDP, DEFICIT, CPI, EXCHANGERATE, IMPORT. The ordering is chosen according to the study by Farzanegan (2007) about oil price shocks and I decided to include the budget deficit before the consumer price index. Because it is assumed to be more exogenous than the consumer price index and the shock in the budget deficit would affect inflation. Surge Fishcer et al.,2002nt and Wallace (1981), Fishcer et al. (2002) and Edwards and Tabellini (1991) concluded that budget deficit has effect on inflation and there is significant correlation in high inflation countries.

GDP accounts for only 8 % of the variance of the of oil exports after 2.5 years. Oil exports account for 3 percent of the variance in the deficit in the long run and is a more important variable than other factors, although very small, suggesting that it has very little effect on the deficit. The oil export change explains about 10 percent of the variance in the real effective exchange rate in the first period, increasing to 25 percent at the end of the period. This may be some evidence of the detrimental role of oil exports on changes in the real effective exchange

rate in the Iranian economy. For the exchange rate, the oil exports have the largest effects, especially in long run over two years.

Despite the 14 percent share of oil export on the variation of GDP at first, this share remains insignificant until the end of the period at about 18 percent. Oil exports have the largest effect on the GDP. For the consumer price index, oil exports initially account for 0.45% and increase to 1.09 % change. The deficit has the largest effect on the consumer price index of about 14 percent. All other variables have marginal shares.

The oil exports increase their share or the variance from 0.25 percent to 5 percent on imports. The exchange rate effects import more than other variables in the long run. Also, the share of CPI increases from 1 to 13 % on the imports. The deficit accounts for almost 2 percent of changes in imports in all the periods and is marginal. Overall these results support those of the Impulse response functions in that oil exports have had little effect on the real economy, implying that the sanctions have not had too adverse effect on the economy overall. Although, oil exports granger cause exchange rate and exchange rate granger cause imports.

Table 3.6: Variance Decomposition

Variance Decomposition of Oil Export:

Period	S.E.	Inflation	Deficit	Exchange rate	GDP	Import	Oil Export
1	0.02	0.00	0.00	0.00	0.00	0.00	100.00
4	0.02	7.55	1.89	3.00	7.47	2.05	78.01
10	0.02	7.79	1.71	6.35	8.10	4.19	71.83

Variance Decomposition of GDP:

Period	S.E.	Inflation	Deficit	Exchange rate	GDP	Import	Oil Export
1	1.60	0.00	0.00	0.00	85.89	0.00	14.10
4	8.69	1.42	3.06	2.85	73.80	2.91	15.92
10	5.15	2.78	4.45	7.03	63.19	3.71	18.81

Variance Decomposition of Deficit:

Period	S.E.	Inflation	Deficit	Exchange rate	GDP	Import	Oil Export
1	0.14	0.00	97.48	0.00	0.23	0.00	2.27
4	0.16	0.45	96.16	1.47	0.20	0.04	1.65
10	0.18	1.49	90.85	2.96	0.55	0.78	3.33

Variance Decomposition of Inflation:

Period	S.E.	Inflation	Deficit	Exchange rate	GDP	Import	Oil Export
1	0.03	90.06	9.37	0.00	0.10	0.00	0.45
4	0.03	82.76	14.10	0.66	0.37	1.63	0.46
10	0.04	76.88	14.48	3.23	1.76	2.53	1.09

Variance Decomposition of Exchange rate:

Period	S.E.	Inflation	Deficit	Exchange rate	GDP	Import	Oil Export
1	0.15	0.72	1.98	80.06	6.49	0.00	10.72
4	0.24	2.33	2.31	61.79	7.09	1.63	24.82
10	0.31	7.98	2.69	52.08	8.91	2.49	25.81

Variance Decomposition of Import:

Period	S.E.	Inflation	Deficit	Exchange rate	GDP	Import	Oil Export
1	0.08	1.99	1.14	0.58	0.60	95.42	0.25
4	0.09	3.74	2.25	2.77	6.55	78.65	6.01
10	0.10	13.36	2.79	13.74	11.24	53.99	4.86

3.8- The asymmetric effect:

In this section the question is whether the relationship between oil export shocks and the macroeconomic variables is asymmetric. There are several studies addressing the relationship between the oil price shocks and the macroeconomy, such as Hamilton (1983) who studied the US economy. Mork (1989) presented an asymmetric definition of oil prices by separating positive and negative oil price changes. This approach is particularly relevant for analysing

sanctions, as it allows us to differentiate between the sanction induced negative shocks and the positive shocks. If the negative shocks have more effect on the macroeconomy than the positive shocks, then this suggests it is the sanctions that are producing that effect.

One of the characteristics of oil shocks to oil revenues is that they are asymmetrical. In general, it is assumed that negative oil shocks reduce domestic production and raise inflation (Mehrara 2008). Increasing oil revenues, increases the inflation level without increasing production. Increases in oil revenues tends to raise government spending. Particularly in Iran's economy, government spending, crowds out the private investors and causes a reduction in the positive effects of government spending (Kazemi et al. 2013). Moreover, when there is a reduction in oil prices, reductions in government spending do not correspond to the oil revenue reduction due to the flexibility in government spending. In this situation, there is economic inefficiency, accordingly, there is an asymmetric effect from oil shocks in Iran's economy.

In this study, Mork's (1989) definition of oil price shocks is used. I apply the same method to measure oil export shocks which distinguishes between positive and negative oil export changes as follows:

$$Posoil = max(0, \Delta\, lnoilr_t) \qquad (3.9)$$

$$Negoil = min(0, \Delta\, lnoilr_t) \qquad (3.10)$$

Lnoilr is the natural logarithm of oil exports (thousand barrels).

3.8.1- Order selection:

To determine the lag order I use the following Criterion. The results are summarized in table 3.7 and 3.8. For the negative shocks, AIC selects the lag order 3 for negative variables. However, according to different criteria and autocorrelation test, the optimal lag length is 4.

Table 3.7: Lag ordering for negative shocks

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-430.54	NA	0.00	11.20	11.56*	11.34
1	-352.35	140.55	0.00	10.13	11.57	10.71*
2	-318.95	54.96	0.00	10.20	12.72	11.21
3	-261.32	86.071*	0.00*	9.65*	13.25	11.09
4	-226.97	46.09	0.00	9.69	14.37	11.57

For the positive shocks AIC, I choose lag order of 4, as it is shown in table 5. According to the AIC and the autocorrelation test I choose the optimal lag of 4.

Table 3.8: Lag Ordering for

positive shocks

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-430.26	NA	0.00	11.19	11.55	11.34
1	-351.30	141.94	0.00	10.10	11.54*	10.68*

2	-317.40	55.77	0.00	10.162	12.68	11.17
3	-269.86	71.00	0.00	9.87	13.46	11.31
4	-225.04	60.13*	0.00*	9.64*	14.32	11.52

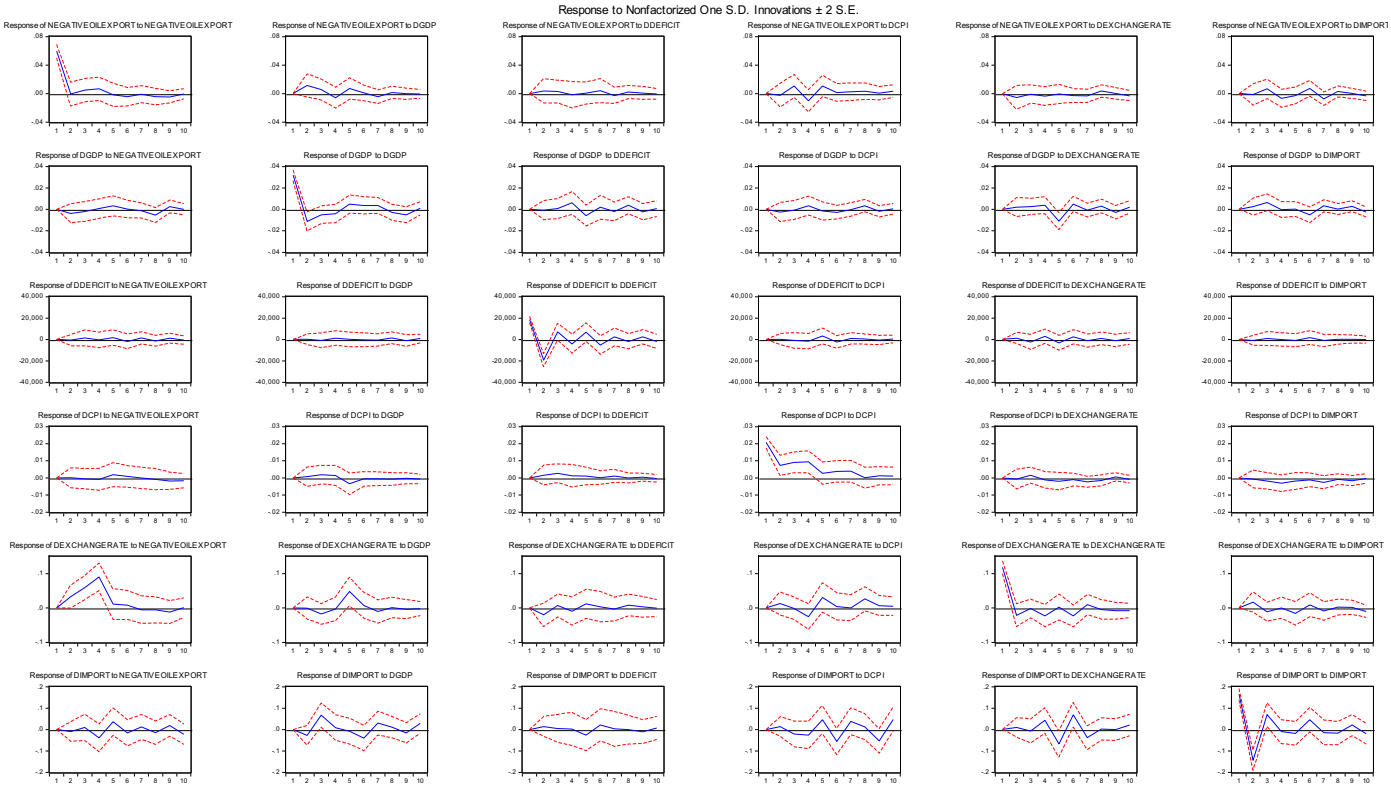
3.8.2- Impulse response function:

Below is the graph of the impulse response functions based on a one standard deviation shock to negative changes in oil exports (Figure 3.7). The response of the GDP is fluctuating. The consumer price index response to innovations in negative oil exports is insignificant. Also, the response of the import and deficit to shocks on negative changes in oil exports is insignificant and fluctuating.

An oil export decrease initially increases the real effective exchange rate significantly until seven periods and reaches its maximum after 4 periods, but with a decreasing trend we observe a negative response.

Considering the response of variables to positive changes in oil exports, in comparison to the negative changes, the main difference can be seen in the response of the real effective exchange rate. The real effective exchange rate responds positively initially but there is a significant negative response from period three and it goes back to its initial level at the end of the period. The results did not show significant difference between the positive and negative effects.

Figure 3.7: Impulse response function (negative shocks)



3.8.3- Variance decomposition:

Tables 3.9 and 3.10 present the variance decomposition of the VAR model. For the consumer price index, the negative oil price shock is 2 percent in the long run and has an increasing trend. However positive oil price shocks account for a little less than the negative shocks. Negative oil export shocks have a larger impact in the long run in comparison with the positive shocks. The negative changes have explained 37 percent in the long run. Which can show the detrimental role of negative shocks on changes in the real effective exchange rate in the Iranian economy. Positive oil price shocks have a 28 percent effect on the real effective exchange rate in the long run. Negative oil export shocks have a marginal effect on the GDP and account for around 7 percent. While positive oil export shocks have a larger effect, which is 3% initially and increases to 15 percent in the long run. The effect of oil export changes are marginal on the deficit. However, the negative shocks have more of an effect than positive shocks. The deficit plays an important role on the consumer price index and accounts for about 15 percent in the long run. Negative oil export changes have significant effects on the exchange rate. Both negative and positive shock s have marginal effect on imports. While GDP effects import by 15% in long run.

Table 3.9: variance decomposition for negative shocks

Variance Decomposition of Negative Oil Export:

Period	S.E.	Oil Export	GDP	Deficit	Inflation	Exchange rate	Import
1	0.05	100.00	0.00	0.00	0.00	0.00	0.00
4	0.06	86.63	4.67	1.28	4.12	1.33	1.95
10	0.06	79.21	5.52	2.04	6.57	2.34	4.29

Variance Decomposition of GDP:

Period	S.E.	Oil Export	GDP	Deficit	Inflation	Exchange rate	Import
1	0.03	8.01	91.98	0.00	0.00	0.00	0.00
4	0.03	6.70	82.39	3.50	1.59	2.57	3.22
10	0.04	7.01	69.71	5.98	2.75	9.41	5.11

Variance Decomposition of Deficit:

Period	S.E.	Oil Export	GDP	Deficit	Inflation	Exchange rate	Import
1	57.39	1.71	0.48	97.80	0.00	0.00	0.00
4	68.21	2.79	0.43	94.58	0.42	1.59	0.15
10	48.53	4.61	0.71	88.92	1.91	3.32	0.49

Variance Decomposition of Inflation:

Period	S.E.	Oil Export	GDP	Deficit	Inflation	Exchange rate	Import
1	0.02	0.12	0.00	9.56	90.30	0.00	0.00
4	0.02	0.14	0.68	14.87	81.98	0.67	1.63
10	0.02	1.97	1.58	15.06	75.75	2.65	2.96

Variance Decomposition of Exchange rate:

Period	S.E.	Oil Export	GDP	Deficit	CPI	Exchange rate	Import
1	0.11	0.29	7.95	2.11	0.53	89.10	0.00
4	0.17	43.72	5.00	2.60	2.74	44.64	1.26
10	0.18	36.69	10.61	4.74	6.90	38.66	2.37

Variance Decomposition of Import:

Period	S.E.	Oil Export	GDP	Deficit	Inflation	Exchange rate	Import
1	0.16	0.46	0.02	1.60	1.75	5.29	90.85
4	0.25	3.15	8.59	2.91	4.45	5.55	75.33
10	0.31	4.46	11.30	3.74	14.05	15.39	51.02

Table 3.10: Variance Decomposition for positive shocks

Variance Decomposition of Positive Oil Export:

Period	S.E.	Oil Export	GDP	Deficit	Inflation	Exchange rate	Import
1	0.05	100.00	0.00	0.00	0.00	0.00	0.00
4	0.06	81.78	10.36	0.84	3.83	1.97	1.19
10	0.06	75.27	11.55	1.162	5.14	5.18	1.67

Variance Decomposition of GDP:

Period	S.E.	Oil Export	GDP	Deficit	Inflation	Exchange rate	Import
1	0.03	3.57	96.42	0.00	0.00	0.00	0.00

4	0.03	9.26	81.43	3.79	1.22	1.62	2.65
10	0.04	15.49	69.22	4.98	1.95	5.06	3.28

Variance Decomposition of Deficit:

Period	S.E.	Oil Export	GDP	Deficit	Inflation	Exchange rate	Import
1	31.92	0.17	0.99	98.82	0.00	0.00	0.00
4	81.74	0.61	0.64	95.97	0.37	2.33	0.05
10	94.54	1.15	1.04	91.73	1.36	3.76	0.92

Variance Decomposition of Inflation:

Period	S.E.	Oil Export	GDP	Deficit	Inflation	Exchange rate	Import
1	0.02	0.93	0.11	10.26	88.68	0.00	0.00
4	0.02	1.10	0.49	15.13	80.56	0.78	1.91
10	0.02	1.45	2.60	14.92	76.26	1.42	3.32

Variance Decomposition of Exchange rate:

Period	S.E.	Oil Export	GDP	Deficit	Inflation	Exchange rate	Import
1	0.13	4.90	9.40	0.46	0.09	85.12	0.00
4	0.15	19.54	12.64	0.54	1.62	64.75	0.88
10	0.18	28.10	13.59	1.25	7.91	47.27	1.84

Variance Decomposition of Import:

Period	S.E.	Oil Export	GDP	Deficit	Inflation	Exchange rate	Import
1	0.16	0.25	1.32	1.49	1.19	1.55	94.17

4	0.24	4.35	8.91	2.49	3.09	2.93	78.20
10	0.31	4.08	14.64	3.10	14.64	10.19	53.32

Cholesky Ordering: Positive oil export, GDP, Deficit, Inflation, Exchange rate, Import

3.8.4- Granger Causality Tests:

Table 3.11:

	DEPENDENT VARIABLES					
	Positive oil export	GDP	Deficit	Inflation	Exchange rate	Import
Positive oil export		0.44	0.89	0.89	0.00**	0.17
GDP	0.11		0.93	0.52	0.03**	0.00**
Deficit	0.89	0.61		0.85	0.99	0.82
Inflation	0.50	0.95	0.81		0.36	0.36
Exchange rate	0.13	0.16	0.77	0.55		0.06
Import	0.38	0.29	0.92	0.76	0.81	

Notes: P-values in parentheses. ** indicates significance at the 5% level.

As we can see there is Granger causality from positive and negative oil prices to the exchange rate and also from GDP to the exchange rate. We can say that the exchange rate Granger causes

imports as well. The exchange rate causes GDP while we have negative shocks. Also, GDP cause imports in negative shock situations.

Table 3.12:

	DEPENDENT VARIABLES					
	Negative Oil Export	GDP	Deficit	Inflation	Exchange rate	Import
Negative oil export		0.80	0.99	0.95	0.00**	0.61
GDP	0.49		0.98	0.57	0.08*	0.00**
Deficit	0.92	0.59		0.89	0.65	0.78
Inflation	0.27	0.92	0.87		0.20	0.36
Exchange rate	0.69	0.03	0.91	0.64		0.07*
Import	0.20	0.21	0.94	0.63	0.70	

Notes: P-values in parentheses. ** (*) indicates significance at the 5% (10%) level.

3.9- Conclusion:

In this chapter vector autoregression model is used to investigate the dynamic behaviour of the economy. The most important macroeconomic variables are used such as real effective exchange rate, GDP, inflation, oil export and oil prices, import and deficit. Impulse response function and variance decomposition are used to determine the reaction of the variables to the shocks and asses shocks behaviour. The results show that the oil export shocks have significant effect on the exchange rate. moreover, exchange rate and GDP have significant effect on each other. Also, variance decomposition approach determine that Oil export has the largest effect

on the exchange rate which conforms to Farzanegan et al (2009) results and the least effect on the deficit. In addition, the asymmetric effects are studied and it is determined that negative oil price shocks have more effect on macroeconomic variables particularly on the real effective exchange rate rather than the positive oil shocks. This is similar to the Farzanegan et al (2009) and Emami et al (2012) studies and is in contrast with the results from the developed countries in comparison with developing countries such as Hamilton (2003). Whilst most of the studies have considered oil prices when studying Iran's macroeconomy, I have used the oil export as an important factor in the macroeconomy and the imposed sanctions. Moreover, In the Jbir and Zouari- Ghorbel (2009) study about Tunisia, the were no effects of oil price shocks on the economy directly. The results help to indicate which variables have significant effects on the others and considering the focus of imposed sanctions on the oil sector, it is shown that mostly the exchange rate is affected so the sanctions focusing on the oil sector do not change the other factor of the economy significantly and so are not successful. In addition, we can investigate more about the exchange rate in the following chapters to indicate the extent of these effects from the sanctions.

Appendix A: conversion from Iranian to Gregorian Years

The Iranian year generally starts on the 21st of March, as such the Iranian quarter 1 contains 10 days of the Gregorian calendar quarter 1 and 80 days of Gregorian quarter 2.

Appendix C: Asymmetric effects

Table 3.13: Autocorrelation test (positive shocks)

VAR Residual Serial Correlation LM Tests		
Lags	LM-Stat	Prob
1	43.68018	0.1775
2	26.96519	0.8620
3	38.25588	0.3674
4	42.04810	0.2254

Table 3.14: Autocorrelation (negative shocks)

VAR Residual Serial Correlation LM Tests		
Lags	LM-Stat	Prob
1	34.75611	0.5277

2	43.59669	0.1797
3	46.74333	0.1084
4	44.53451	0.1555

Chapter 4: Sanctions and the Macroeconomy: A Markov Switching Approach:

4.1- Introduction:

In this chapter I will analyse the effects of the economic sanctions applied to Iran on the wider macroeconomy using a regime switching approach. The goal of sanctions analysis is to determine if the sanctions have had any effect on the economy and how the target country responded to the imposed sanctions. Economic sanctions in Iran have been imposed in the form of economic restrictions and trade barriers.

The aim of economic sanctions is to put pressure on the target economy and apply economic restrictions on the target country to achieve specific political changes. By applying different policies like the supply of more public goods the target country's government tries to reduce the negative effects of sanctions. The government response and reaction of the macroeconomy in general to sanctions can make sanctions ineffective. In this chapter I apply the Markov switching model to analyse Iran's economic regime changes in response to imposed economic sanctions. Markov switching models are common models which present time variation in the parameters through different regimes and the current regime value depends on the previous period. The economic variables may have structural breaks due to different political, financial and economic arrangements and Markov switching model is capable of determining the behaviour pattern of the data during specific periods of time and this is why the Markov

switching model is chosen to analyse the sanctions and macroeconomy variables in Iran. Moreover, this model can determine several temporary changes.

There has been some research which has focused on the effects of sanctions and other studies that have focused on the oil price shocks and GDP relationship using the Markov switching model, these studies include ~~Mehmet~~ Balcilar et.al. (2015). Balcilar et al. (2015) analysed the effect of oil price shocks on the S&P 500 index by applying a two regime Markov-switching model, in a VECM setting with a low and high volatility regime. They used monthly data from 1859 to 2013. They defined a two variable model and the results indicate that high volatility regimes are more prevailing before the Great Depression and after 1973. They determine that the MS approach is one of the most appealing methods to tackle structural breaks and a good fit for time series which experience shocks and regime shifts. Imposed sanctions have mostly targeted oil exports and the Central Bank in order to reduce Iran's oil revenue and weaken the currency.

The economy of Iran is highly dependent on oil exports, it is the basis of wealth creation and economic growth. Over the past years, the international community, mostly the United States of America, the European Union and the United Nations have imposed several economic sanctions on Iran due to its contentious nuclear program among other international political issues. The economic sanctions are intended to compel Iran to suspend its nuclear programs.

This chapter investigates the effects of sanctions on Iran's macroeconomy, which are mainly due to Iran's nuclear program, as well as their effectiveness in achieving the set objectives. The data is collected from the Central Bank of Iran which includes seven macroeconomic variables namely the exchange rate, GDP, trade deficit, CPI, imports, oil export, and oil price for the

period between 1990 and 2017, at the moment the data are available until 2017. The Markov Switching Model is employed to study the effects of economic sanctions.

4.1.1- Introduction to Iran:

Macroeconomic variables are liable to shocks which are the cause of breaks in the time series. Economic sanctions are used to make targeted changes in a targeted country by restricting the economic activities and performance, which is likely to cause such a break. Diebold et al (1994) extended Hamilton's (1989) Markov Switching model and assumed that the regime switching probability depends on economic fundamentals. They allowed time varying transition probabilities by using observable covariates. In the extended model exogenous explanatory variables and dependent variables' lagged values are included. This approach is more flexible than fixed transition probabilities, however, choosing variables or functional specifications is not always clear.

Analysis about Iran's macroeconomy and the sanctions that the country has faced are limited and rare, so this study will contribute to the literature on sanctions and breaks. However, it may be the case that the switching doesn't pick up much change, as Naghavi et al (2015) believed that economic sanctions imposed on Iran during different years, has led to the country's stabilization rather than fulfilling the aim of the sanctions.

As explained by Zarouni (2016), the Iranian oil industry has become the basis of wealth creation in the modern society. It plays a crucial role in helping the country achieve its target growth and development plans. Over the past decades, Iran's policymakers have come up with lots of essential economic development plans. Despite this, the country has also been recently

subjected to various economic sanctions, which are largely considered to be obstacles in achieving its development plans and goals (Zarouni (2016)).

Over the past decades, Iran has been subjected to a number of economic sanctions, which are used as tools to weaken the country's economic power. According to Petrescu (2008), most economists and politicians believe that sanctions would lead to the affected country undergoing a change of political and economic behaviour. In the recent past, the United Nations (UN) and the United States of America (USA) have been increasingly using economic sanctions in order to achieve specific foreign policy objectives (Zarouni 2016). They impose the sanctions either unilaterally or through the United Nations Security Council.

According to Petrescu (2008), economic development is the most important policy from Iran's perspective. *Iran Perspective Document 1404* expresses the above interest in the first two paragraphs. The first paragraph identifies, "health, welfare, food security, social security, equal opportunities, income distribution, strong families away from poverty, corruption, discrimination, and benefit from a favourable environment" as the key development concerns (Farzanegan 2013). Iran needs economic development in order to achieve the above components and sanctions are an obstacle to the country's ability to achieve the above components of economic growth.

In theory, economic sanctions lead to internal inefficiencies resulting in slow economic growth and development. According to Zarouni (2016), sanctions affect large parts of Iran's economy in six main ways which are decreasing investment, limiting access to foreign exchange and finance, rising inflation and unemployment, and slowing economic growth.

The current empirical study analyses the impact of past economic sanctions on Iran's macroeconomy. The primary goal of the empirical study is to determine whether the economic sanctions have affected the country's macroeconomy or not through creating times when sanctions are having some effect and times when this is not the case, as well as the extent of their success in achieving the intended outcomes. The chapter also determines how Iran has responded to the imposed economic sanctions. The Markov switching model was applied to study this research phenomenon by analysing the effects of two regimes on the Iranian economy, the first regime being with no sanctions, the second including the sanctions. Political and economic decisions can make structural breaks for some economic variables overtime and MS approach models the behaviour pattern of the data during a time period and deals with structural breaks. Markov switching approach can estimate changes of dependent and independent variables simultaneously and moreover the permanent or temporary changes can be determined.

Some literature strongly believe that recent economic sanctions imposed on Iran's oil and financial sectors are taking a toll on its macroeconomy (Morin and Steven 2000). However, other literature believes that Iran's macroeconomy is doing well because the country has initiated effective counteractive measures (Marinov 2005). Therefore, understanding how the economic sanctions are affecting Iran's economy is an important concern to everyone including researchers, academicians, government policymakers, as well as investors and developers.

Iran is facing numerous economic challenges, some of which have been accentuated by the past and current economic sanctions (Drury (1998)). According to Kaempfer and Anton (1992), the main challenges include high youth unemployment, high inflation rates, the depreciation of

the currency, and the abolition of subsidiaries as well as an economic downturn. The inflation rate is anticipated to worsen in the coming years mainly due to currency devaluation. It is not evident whether the economic sanctions imposed by the international communities on Iran are achieving their primary objectives. They could be useless if Iran is able to respond effectively and counteract the effects of the imposed sanctions. Just like other countries, Iran could have been able to shield itself from the effect of the economic sanctions imposed by the international community including the United Nations and the USA. Little information has been provided by the international community on the ability of Iran to shield itself from the worst effects of the economic sanctions.

In addition to analysing the sanction's effects, we will see how Iran has been responding to them. Also, the chapter determines whether the economic sanctions have been successfully achieving the intended outcome, which is essential in determining their continued use.

The paper features five sections. The first presents the background. The next reviews the literature. The chapter discusses the methodology and Markov switching model. The fourth and fifth sections presents findings and conclusion respectively.

Table 4.1: Multilateral Economic sanctions against Iran

Years	Principal	Purpose
2006	UN, USA	To stop nuclear program
		To prohibit transfer/sale of nuclear equipment/materials

2007	UN, USA, EU	To prevent institutions/individual from making financial commitment to Iran
2008	UN	To stop collaboration with Iran's credit and national banks
	UN, USA	To compel Iran to enforce provision of previous UN resolutions
2010	UN	Intensification of former resolutions and penalties
	EU, UN	A ban on joint venture between Iran and European countries
2011	UN, EU	To expand the scope of nuclear sanction

4.2.1- Effects of the Economic Sanctions:

As explained by Pape (1998) economic sanctions have caused difficulties in the oil-dominated Iranian economy. Oil exports have been gradually declining due to economic sanctions imposed by the USA, EU, and UN.

Economic sanctions have severe social and economic effects (Drury, 1998). The country has reduced access to necessary materials and products for its energy and oil sector. As a result, a number of oil companies have withdrawn from Iran thereby causing a decline in oil production. Also, many international companies are afraid of investing in Iran due to the economic sanctions.

The literature has also indicated that the economic sanctions have caused basic goods to become expensive for the public. Smuggling has also increased since it is the easiest way to get around the economic sanctions (Morin 2000)). However, smuggling is weakening the civil society in Iran. In addition, the inflation rate has also been increasing due to economic sanctions.

4.2- Literature review of Markov Switching Model:

The Markov switching model has been a common approach to studying the business cycle in different countries. This model was originally proposed by Hamilton (1989) and is one of the most important macroeconometrics models where there is regime changing present. It is a nonlinear approach to examining the asymmetric characteristics of a model, Hamilton (1989) introduced Markov switching models which allows different mean growth rates of a time series over unobserved states. Hamilton (1989) proposed two regime Markov switching models and examined the US output growth.

The Markov switching model has been used widely for economic and financial analyses for instance Hamilton (1989), Goodwin (1993), Kim and Nelson (1998). Hamilton (1989) and Chauvet and Hamilton (2004) examined business cycles in the US applying the Markov switching model. while Raymond and Rich (1997), Holmes and Wang (2003) and Clements (2002) have used the Markov Switching approach to investigate the impacts of oil shocks on the UK and US business cycles. The Markov switching model is one of the most common models in literature for non-linear time series. The Markov switching model includes multiple equations to characterize the behaviour of time series in different regimes. By switching between regimes, the more complex dynamic patterns are determined (Kuan 2002).

Saltoglu et al (2003) examined Turkey's business cycle using the Markov switching approach. Stanca (1999) used this approach to study Italy while Cologni and Manera (2009) focused on the developed countries business cycle, but applying the Markov switching model to oil exporting countries like Iran are rare. Several studies have been carried out with an aim of establishing the effect of oil prices on the economy of a particular country (Jiménez-Rodríguez, 2015; Mohseni & Modallal, 2017).

Raymond and Rich (1997) examined the nonlinear relationship between the macroeconomy and oil price shocks between1952 and 1995 and presented evidence of nonlinearity by using oil prices in a US output MS model and used real oil prices and real US GDP data. They investigated the relationship between oil price shocks and output fluctuations in the US by using the two regime Markov switching model of Hamilton (1989). They suggested oil price shocks play a role in output fluctuations and the oil price has strong impacts on the macroeconomy. Real oil price increases explain the switches in the mean growth rate of GDP. Also, the oil price explains the shift during the 1990-91 recession. On the other hand, the effects of oil price shocks on GDP growth cannot define the extent of the shift in the output at the time of any low growth phases. My approach follows Raymond and Rich (1997). They also determine that oil price shocks mostly affect the mean of growth rather than transition probabilities.

Raymond and Rich (1997), have used the maximum likelihood (ML) approach through the nonlinear filter algorithm from Hamilton (1998) to estimate the parameters of their model. Using the filter probability allow an interference for the unobserved regime in each period of time. The filter probabilities are important in forecasting the switches. The literature about the

relationship between the oil price and macroeconomy have paradoxical results. Raymond and Rich (1997) indicated that oil price shocks have significant effect on economic growth. They used the two regimen Markov Switching Model of Hamilton (1989) for examining the oil price rises and USA output growth relationship and rejected the statistical coincidence between oil prices and output. The key insight of the Raymond and Rich (1997) study, which is important in my study is that the relationship between the oil sector and macroeconomy is complex and involves more than one regime. In the case of Iran one of the regimes is when sanctions are imposed.

Kim and Loungani (1992) identify that the oil price shock contribution to the variance of output is moderate. The negative effect of oil price shocks on the macroeconomy have been reported by Hamilton (1983), Kilian (2008) and Mork (1994). Reboredo (2010). They analyse the nonlinearity in oil price shocks and the stock markets by using the Markov switching approach and reported the negative impact of oil on the stock market. They investigated Canada, Germany, UK and US. Basher et al. (2016) reported a nonlinear relationship between oil prices and the exchange rate by using the Markov switching model. Their results are the same for oil importing countries as well as the oil exporting countries.

Much of the literature has focused on the oil and macroeconomic relationship. Most of the literature indicates a significant effect of oil prices on economic variables such as Cologni and Manera (2006) who studied the output growth and oil price by using the Markov switching model. They indicated a significant effect of oil price shocks causing recessions in G-7 countries. Simon (1996) applied the Markov Switching model to examine inflation in Australia

and modelled the 1960s inflation by a two-regime specification and indicated the regime change in the 1970s and 1990s.

Wiese (2016) also examined the relationship between oil price shocks and the stock market by using the Markov switching model for the US, UK, Canada, Germany Netherland and Japan. and found significant effects in high volatility regimes and a significant effect of the oil price on the stock market in general.

Moreover, Morier and Teles (2016) showed that a rise in oil prices following an elongated period of stability resulted in pronounced macroeconomic consequences. Pinho and Madaleno (2016) used a two-regime multivariate Markov-Switching Vector Autoregressive Model (MS-VAR) to show the correlation between oil prices and stock returns. they showed that there exists a strong correlation between the oil prices and the general prices of items in a given sector.

The results showed that the oil and gas sector have a significant effect on stock returns. It also showed that the response to oil price changes has more impact for high oil prices. This makes the oil and gas sector more sensitive to oil price changes compared to other sectors. Leonhardt, Ware, and Zagst (2017) used a co-integrated regime-switching model approach with jumps to predict the future prices of natural gas. The Markov-switching approach was used to predict the log-future prices based on seasonality and a regime-dependent factor process in a linear combination. The results showed different states of the underlying volatility in the future. The Markov chain switching approach can also be used to explain the dynamics of future growth based on past data (Morier & Teles, 2016).

Salehi (2015) applied the Markov switching ARMA model to investigate Iran's business cycle and determinants of GDP from 1988Q1 to 2008Q2. They have considered nonlinearity and co-movement for the Iranian economy and found that using MS is satisfactory.

4.3- Methodology:

The Markov switching model, which was introduced by Hamilton (1989) allows for time series data to account for periodic changes which occur through switches in various states. The Markov switching model is important due to the fact that it can allow changes in both the mean and variance and also allows for multiple breaks, so I have used the Markov switching model to analyse the effects of sanctions on the macroeconomy, as sanctions are a different state for the economy relative to normal conditions. The MS model allows for either permanent or many temporary changes to the data. The Markov switching model gives us better significance in the estimated parameters. The 2-state Markov switching is used to see the behaviour of the macroeconomic variables in 2 regimes which one regime is when sanctions exist and the other regime is without sanctions.

The macroeconomic data has been collected from the Central Bank of Iran and the IMF. The Quarterly data were downloaded from the Central Bank of Iran's website. The data covers the period between 1990 and 2017 during which time the country faced a number of economic sanctions imposed by the USA, EU, as well as the UN (see background chapter).

The main variables considered in the dataset include the *Consumer Price Index* (CPI), exchange rates, *Gross Domestic Product* (GDP), imports and oil exports. The variables were selected because they provide a strong indicator of the country's macroeconomy hence are able

to measure accurately the effect of economic sanctions. Oil exports are chosen as Iran economy's dependency on oil and the sanctions targeting the oil sector. Moreover, these are the data that have been used in related literature such as Raymond and Rich (1997) and Pesaran (2012).

4.4.1- The Markov Switching Model (MSM):

Hamilton (1989) initially proposed the use of Markov switching models for characterizing fluctuations in economic series. The MSM is essentially the sum of the autoregressive and Markov processes. It allows the mean growth rate of the data to vary over time across different states. According to Raymond and Rich (1997), the model works with the assumption that periodic changes may be observed in the time series data such as switching between sanction and non-sanction regimes. Therefore, such changes are accounted for by switching states and allowing average durations and generating a process in which each state differs.

The Markov switching approach is useful for modelling nonlinear time series where the data is assumed to have a different behaviour or structural breaks in different regimes. Dummy variables are used to estimate the model if the dates of the regime switches are known. For this study, the regime switches are expected to coincide with the dates when the economic sanctions were imposed.

The research analyses the relationship between shocks due to economic sanctions and the fluctuations in the dependent variables. The question was explored by incorporating the variables into the Markov switching model and examining their capacity to generate shifts. In essence, the modelling strategy adopted for this research uses shifts between states in the

Markov framework to evaluate the effect of economic sanctions on variables representing the Iranian macroeconomic conditions. I will follow the approach used in Raymond and Rich (1997), which was conducted on the US business cycle and oil prices by using the Markov switching model. Since the impact of the oil sector is affected by the regime switching characteristics of the data. They investigated the impact of oil price fluctuations on the US economy and I am investigating the impact of the restrictions on the Iranian economy, specifically restrictions imposed on the oil sector using the Markov switching model. The imposed sanctions are acting as exogenous shocks to the economy.

Model specification

Consider a general autoregressive process of order p. Suppose Y_t and μ are the vector of variables and mean of the model respectively, then the first order M-state Markov switching model can be given by the equation below.

$$Y_t - \mu S_t = \emptyset_t(Y_{t-1} - \mu S_{t-1}) + \cdots + \left(Y_{t-p} - \mu S_{t-p}\right) + \varepsilon_t \quad (4.1)$$

Where

$$\varepsilon_t \sim N(0, \delta_{S_t}^2) \quad (4.2)$$

$$\mu S_t = \mu_1 S_{1t} + \cdots + \mu_M S_{Mt}, \quad \rightarrow \quad \mu S_t = \mu_1 S_{1t} + \mu_2 S_{2t} \quad (4.3)$$

$$\delta_{S_t}^2 = \delta_1^2 S_{1t} + \cdots + \delta_M^2 S_{Mt}, \quad \rightarrow \quad \delta_{S_t}^2 = \delta_1^2 S_{1t} + \delta_2^2 S_{2t} \quad (4.4)$$

$$P[S_t = j | S_{t-1} = i] = P_{ij}\,;\ i, j = 1,2,3, \ldots \ldots, M \quad (4.5)$$

$$S_{Mt} = 1 \text{ if } S_t = m, \text{and } S_{mt} = 0, \text{otherwise} \quad (4.6)$$

M and P_{ij} refers to the number of regimes (switches) and the transition probabilities of switching from one regime to another respectively. And S_t can have two values either 0 and 1.

The transition probabilities

In practice, it is almost impossible to observe directly the prevailing regimes but presume its behaviour via the observed behaviour of variables (y_t). The transition probabilities add up to one and follow a Markov process. They can be represented in matrix form. The transition probabilities are estimated using the maximum likelihood method.

The Markov switching model is used for series that are considered to change over a set of states. The time and duration of switching between the states is random. For example, the process which generates changes in economic growth between its expansion and recession.

4.4.2- Structural breaks:

Economic variables may have structural breaks over time due to different factors like political, financial and economic decisions. The Markov switching model determines the behaviour of the data over time. The Markov switching model allows several changes over the short run or the long run. Switching models can determine the exact times of changes and breaks (Hashemi

et al. 2010). Also, the Markov switching model can estimate the transitions of dependent and independent variables at the same time (Mehregan et al. 2013).

In the Markov switching model the probability of being in a specific regime depends on the previous period's regime. Transformations between regimes are driven by fixed probabilities. In Markov switching models the timing of the breaks is endogenous which is different to other models with breaks. In fact, breaks are not imposed specifically but interventions are determined through probabilistic estimates of the most likely regime prevailing at each time (Simon 1996). Parameter estimations for the regimes are produced by maximum likelihood process.

The probability for a specific state is identified by the ratio of the likelihood of that state and the total likelihood for both states. On occasions with specific data, the economic time series determines the breaks endogenously in their behaviour, corresponding with events such as financial crises (Hamilton, 2005).

Considering a change in the behaviour of a variable y_t. This can be shown as:

$$y_t = cs_t + \varphi y_{t-1} + \varepsilon_t \qquad (4.7)$$

where s_t is a state variable and a random variable which is either 0 or 1 in a two regime model or (1, 2,…,N) in an N state model. The probability of s_t being equal to a value like j is:

$$Pr\,(s_t = j|s_{t-1} = i,\ s_{t-2} = k,...,y_{t-1},y_{t-2},...) = Pr(s_t = j|s_{t-1} = i) = p_{ij} \qquad (4.8)$$

Which in two regime model can be simplified as:

$$Pr(s_t = 0|s_{t-1} = 0) = 1 - Pr(s_t = 1|s_{t-1} = 1) \quad (4.9)$$

The transition probability p_{ij} represents the probability of transforming from state i at time t to state j at time t-1, the transition probability is an (N*N) matrix. The transition matrix in the two regime Markov model is:

$$p = \begin{bmatrix} p_{11} & 1 - p_{22} \\ 1 - p_{11} & p_{22} \end{bmatrix} \quad (4.10)$$

In Markov switching models, in addition to the independent variables and ε_t, y_t is function of s_t .

We can determine a simple model to study the effect of sanctions on the economy by:

$$y_t = c_0(s_t) + c_1(s_t)x_t + \sigma_t(s_t)\varepsilon_t \quad (4.11)$$

ε_t has zero mean and normal distribution $\varepsilon_t \sim N(0, \sigma_t^2)$ and c_0, c_1 and σ_t have two values as the model switches between two regression models.

Y_t are endogenous variables and x_t are exogenous variables and in this study as an indicator of sanctions such as oil revenue shocks in this case. In other word, the Markov switching process is the functional form of the relationship between x_t and Y_t and the residual variance change over time.

According to the model, in order to study the effect of oil sanctions on the regime changes in other variables the following model is determined. As an example, if we study the GDP our model will be:

$$GDP_t = c_0(s_t) + c_1(s_t)oilexport_t + \sigma_t(s_t)\varepsilon_t \quad (4.11)$$

Here Y_t is vector of (n×1) of endogenous variables.

4.4.3- Smoothed regime probabilities:

In the Markov switching model, the time series data is assumed to occasionally follow a disrupted behaviour. The disruption is produced by shocks leading to different regimes, states, and dynamics governed by unobservable state variables. Filtered probabilities provide references about the S_t on the conditional information up to a certain time t. on the other hand, smoothed probabilities refer to the inferences about S_t regarding all information provided by the sample. We can evaluate structural breaks from the smoothed probability. The smoothed probability is from the estimated model and gives informative inference about the regime that the data lies in at the time. Smoothed probabilities are required for dating the structural breaks, which is considered to occur if $p_{11} > 0.5$. In other words, there is a shift from one regime to another if the smoothed probability is greater than 0.5. The smoothed probability helps to identify when a regime has happened.

4.4.4- Expected duration:

An important question to be considered in a Markov switching model is the expected duration of the switches between regimes. The question is, given that we are in one regime or state, how long does it take to switch to the next regime or state. In order words, on average, how long does a regime last? The expected regime duration is given by the formula below.

$$E(D) = \frac{1}{1-P_{ij}} \qquad (4.12)$$

Expected duration for regime 1 is:

$$E(D) = \frac{1}{1-P_{11}} \qquad (4.13)$$

And expected duration for regime 2:

$$E(D) = \frac{1}{1-P_{22}} \qquad (4.14)$$

The Markov Switching Model is used for this analysis and the model is tested with each of the main variables of interest to determine the effect of economic sanctions on Iran's macroeconomy.

4.4- Data Analysis and Estimation:

The results of the data analysis are presented and discussed in this section. The chapter presents the data used and the statistical interpretation and inferences of the results. The results of the data analysis are presented in the form of tables, charts, and groups.

4.5.1- Augmented Dickey-Fuller test:

The *Augmented Dickey-Fuller* test was used to determine the stationarity of the data set. The results showed that the data set was non-stationary. Therefore, to proceed with the Markov Switching Model, the data were transformed into differenced stationarity form by computing the first difference.

Variables were used to measure the effect of economic sanctions on Iran's macroeconomy, they are defined as follows:

dExchange Rate – the value of Iranian currency with respect to the USA dollar

dGDP – gross domestic product

dCPI – consumer price index

dImports – the value of quarterly goods imported into the country

dOil Export – the quarterly value of oil exported by the country

The coefficients for the model were estimated for each variable using the available data. A summary of the results is presented in the table on the next page. Comprehensive test results for each variable are tabulated in Appendices.

Table4.2: Summary of estimated Model Parameters

Variable	dExchange Rate		dGDP		dDeficit		dCPI		dImports		dOil Export		dOil Price	
	Coeff	Prob	Coeff	Prob	Coeff	Prob	Coeff	Prob	Coeff	Prob	Coeff	Prob	Coeff	Prob
	Regime 1													
C	-0.39	0.01	0.01	0.00	-186.9	0.97	0.06	0.00	0.00	0.62	0.01	0.62	-0.06	0.64
LOG (σ)	-1.00	0.00	-3.72	0.00	10.43	0.00	-3.57	0.00	-2.00	0.00	-1.86	0.00	-1.10	0.00
	Regime 2													
C	0.02	0.00	0.01	0.44	-84.25	0.73	0.03	0.00	-0.07	0.72	-0.00	0.07	0.03	0.01
LOG (σ)	-3.17	0.00	-2.86	0.00	7.23	0.00	-4.36	0.00	-0.42	0.09	-3.47	0.00	-2.29	0.00

Variables	dExchange Rate		dGDP		dDeficit		dCPI		dImports		dOil Export		dOil Price	
	P11-C	P21-C	P11-C	P21-C	P11-C	P21-C	P11-C	P21-C	P11-C	P21-C	P11-C	P21-C	P11-C	P21-C
Coefficient	-0.90	-2.86	4.08	-2.73	3.05	-2.91	1.94	-2.85	3.34	-1.08	-0.28	-1.23	0.86	-3.17
Std error	1.05	0.51	1.20	1.98	0.90	0.85	0.84	0.83	0.80	0.83	0.80	0.50	1.19	0.91
z-Statistic	-0.85	-5.60	3.37	-1.37	3.36	-3.39	2.29	-3.42	4.17	-1.30	-0.34	-2.43	0.72	-3.46
Probability	0.39	0.00	0.00	0.16	0.00	0.00	0.02	0.00	0.00	0.19	0.72	0.01	0.46	0.00

Statistical interpretation, inference, and discussions on the table above are presented on the next page.

Table 4.2 above presents the model coefficients for each of the variables representing the Iranian macroeconomy and the variables are mostly significant. C is the regression constant while σ is the respective standard deviation. The probability values can be used to determine the significance of the model as well as the effect of economic sanctions on Iran's macroeconomy by the standard errors. The element is considered significant if the probability value is less than the alpha (5%). Using the above criteria, Table 4.2 shows that there are significant effects from the Exchange Rates and CPI because they all have probability values less than 5%, for both regime one and two. However, there is no significant effect from the, oil exports, imports and GDP because they have probability values greater than 5% in at least one regime. Using the probability value criteria, it can be concluded at the 5% level of significance that economic sanctions which were aimed at the oil sector do not have significant effects on Iran's imports and oil exports. During the long period of imposed sanctions, the Iranian economy could have had a moderate expansion despite some recessions. However, it does have significant effects on the exchange rate and CPI. The Mean for the first regime for the exchange rate is 0.4 and 0.03 for the second regime. For the CPI the mean is 0.06 and 0.03 in the first and second regimes respectively. In state 1 (0.4) the average exchange rate and in state 2 (0.03) is the average exchange rate. Also, the estimated growth rate of GDP is 0.012% in the first regime and 0.011% in the second regime. The standard deviation in regime 1 is 1 and in regime 2 is 3 for the exchange rate. We can also see the transition matrix parameters for each variable chosen to represent the macroeconomy. They are transition parameters which determine the shifting from one state to another.

4.5.2- Constant Markov Transition Probabilities:

Having eliminated some macroeconomic variables because they are less affected by economic sanctions due to a lack of significance, we now compute the transition probabilities for the ones that are significant. The probabilities show the chances of shifting between the states. The probabilities are compiled in the table below. Table 3 is a summary of the estimation of the two models with different transitions which are the exchange rate and CPI.

Table 4.3: Constant transition probabilities

	Exchange Rate		CPI	
States	**1**	**2**	**1**	**2**
1	0.9334	0.0665	0.9550	0.0449
2	0.6927	0.3072	0.2984	0.7015

The table shows the Markov Transition Probabilities for the two macroeconomic variables that are significantly affected by the economic sanctions. In particular, they indicate the probability of the macroeconomic variables shifting from a state with no sanctions to the state when the economic sanctions were imposed. In this case transitions from regime 2 to regime 1 are less likely than transitions in the other direction. There were high probability values indicating a greater affinity

to shift states due to the effect of the economic sanctions. For the exchange rate, the transition probabilities are 0.93 and 0.3 for state 1 and 2 respectively. And 0.95 and 0.70 for the CPI.

4.5.3- Smoothing Probabilities:

Smoothed probabilities were computed for each variable to provide a reference to the date of the structural break that is when the transition occurred due to the potential impact of economic sanctions. The transition is considered to occur whenever the smoothing probability is greater than 0.5. The smoothing probabilities for the macroeconomic variables that were significant are presented in the following figures.

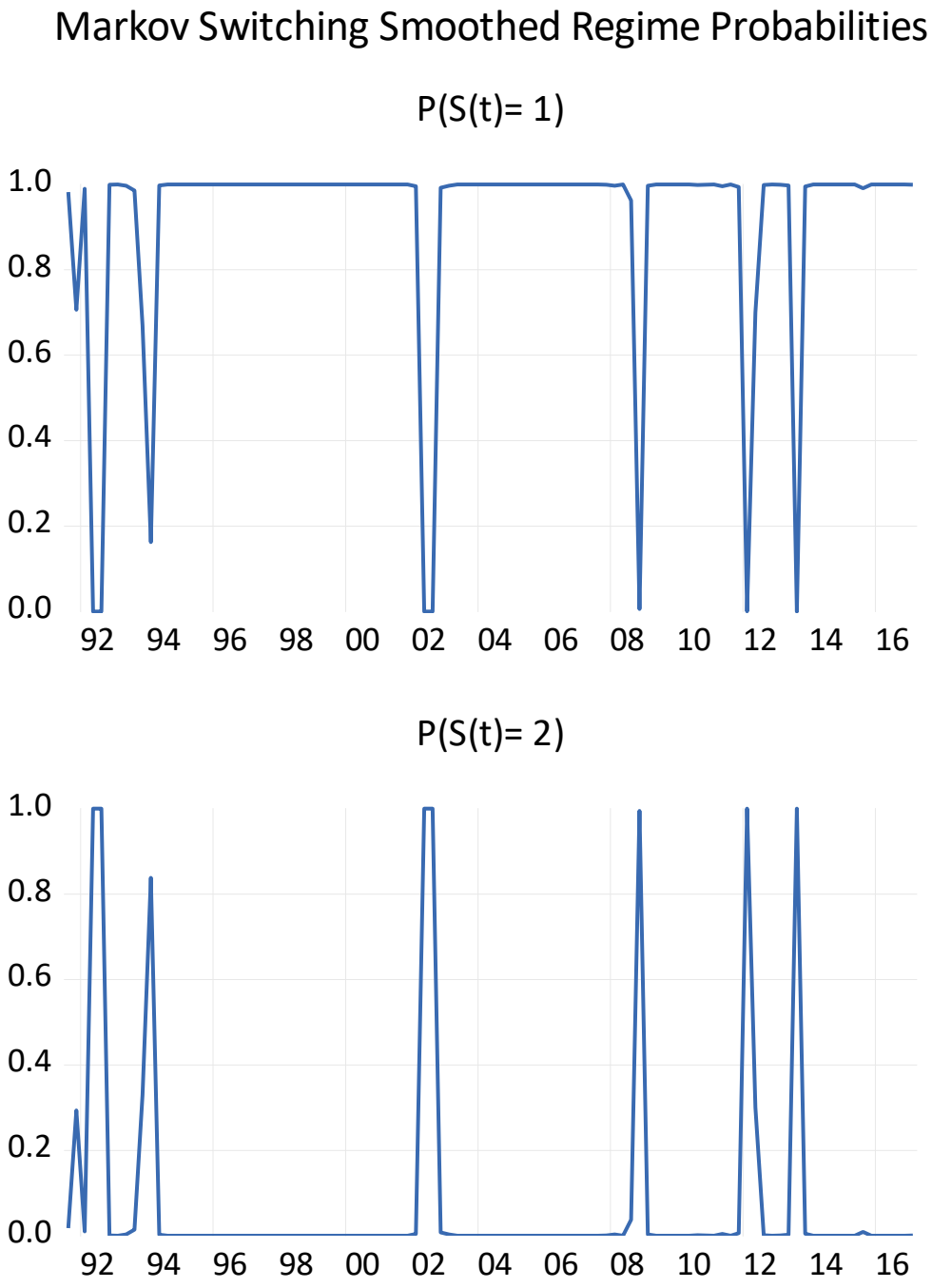
Table 4.4: exchange rate model

Variable	Coefficient	Std. Error	z-Statistic	Prob.
Regime 1				
C	-0.39	0.16	-2.35**	0.01
LOG (σ)	-1.00	0.26	-3.71**	0.00
Regime 2				
C	0.02	0.00	0.00	5.69
LOG (σ)	-3.17	0.09	-33.8**	0.00
Transition Matrix Parameters				

P11-C	-0.90	1.05	-0.85	0.39
P21-C	-2.86	0.51	-5.60**	0.00

Notes: A ** indicates significance at the 5% level.

Figure 4.1: Smoothed Regime Probabilities for the Exchange Rate



The figure indicates the smoothed regime probabilities for the exchange rate variable. The probabilities are for the first transition state only. A comprehensive chart showing smoothed regime probabilities for both first and second states are found in Appendix H. the graph clearly indicates that the smoothed regime probabilities were greater than 50% in 1992, 1993, and 2002, 2008, 2012 and 2013 which corresponds to the dates of the structural breaks. From the literature review, these dates also correspond to the time when there were various economic sanctions imposed on Iran, which indicates that the variable was greatly affected by the sanctions. In the 1980s the US increased the sanctions imposed on Iran, and in 1987-1988 the US applied the second set of sanctions on Iran. In 1989 frozen Iranian assets were released by the US. In 1992-93 the Iran-Iraq act imposed and banned transfers of controlled technology and goods. In 1994-1995 the sanctions were expanded and included the ban on trade with Iran and investment. In 2001 and 2002 there was executive order 13224 and a press conference which declared that Iran had built nuclear facilities, with the suggestion of more sanctions to come in the future. 2008 , 2012 and 2013 were the time that the UN, EU and US sanction were expanded on Iran respectively.

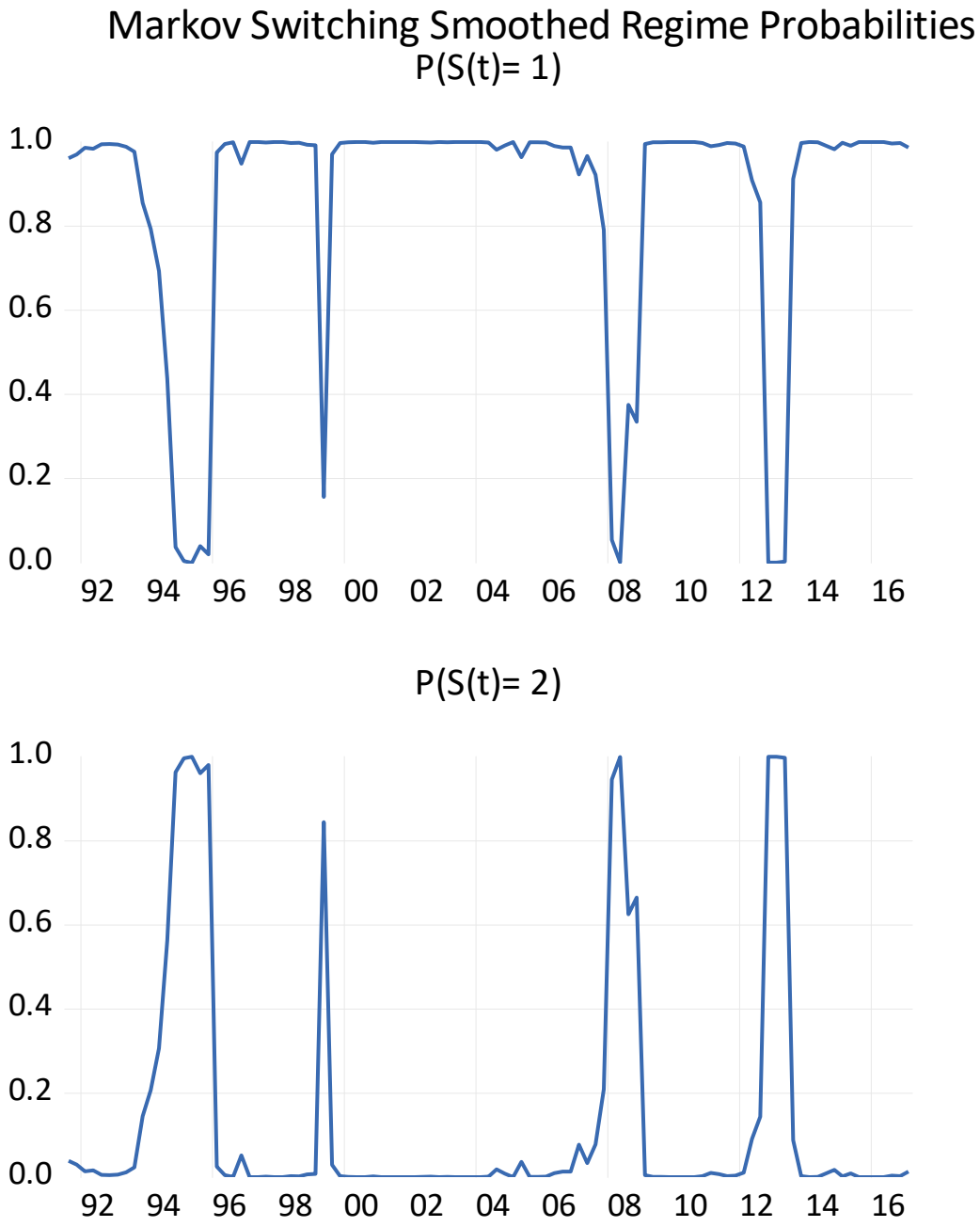
Table 4.5: consumer price index (CPI)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
Regime 1				
C	0.06	0.00	8.19**	0.00

LOG (σ)	-3.57	0.16	-22.01**	0.00
Regime 2				
C	0.03	0.00	16.03**	0.00
LOG (σ)	-4.36	0.14	-30.87**	0.00
Transition Matrix Parameters				
P11-C	1.94	0.84	2.29**	0.02
P21-C	-2.85	0.83	-3.42**	0.00

Notes: A ** (*) indicates significance at the 5% (10%) level.

*Figure **4.2**: Smoothed Regime Probabilities for CPI*



The graph above is the smoothed regime probabilities for the CPI given for the first state. A comprehensive graph that includes both first and second states is found in Appendix I. As can be seen, the structural breaks occurred in 1993-1995, 1999, and 2007-2008 and 2012-2013. Some of these periods correspond to dates when economic sanctions were imposed on Iran, as explained in the literature. As you can see regimes are slightly persistent in this model. In 1994 there was a ban on U.S. government procurement and imports to the US and in 1995 the US extended sanctions focusing on trade and investments with Iran targeting the energy sector. In 2008 restrictions were imposed on Iran's access to the U.S. financial system. The US continued extending sanctions in 2007 to 2010 each year and added some companies to the sanctioned lists in 2007. Also, from late 2006 the UN imposed sanctions on Iran and extended the sanctions in 2007, 2008 and 2010. EU ban was imposed on importing Iranian oil in 2012.

4.5.4- Expected duration:

The expected durations were computed to determine how long it takes before a transition occurs from one state to another. The summary of the expected durations are compiled in the table below. The numbers indicate quarters of a year.

Table 4.1: Expected constant durations

	Exchange Rate	Consumer Price Index

State 1	15.03	22.26
State 2	1.44	3.35

As the table indicates, most variables take a longer time to shift from one state to the next when economic sanctions are imposed. It implies that the effects of the economic sanctions are not experienced immediately in the macroeconomy and it might take some time before the effects are felt. The Iranian economy stays 15 quarters in the regime before it switches due to the exchange rate and stays 22 quarters in the regime before it switches due to CPI.

This part documents the results of the data analysis alongside the accompanying statistical interpretation and inferences. The analysis revealed that economic sanctions have significant effects mainly on two macroeconomic variables namely the exchange rate, and the consumer price index. The other macroeconomic variables, oil exports, and imports, are not greatly affected by the economic sanctions.

4.5.5- Oil exports:

As Iran is one of the major oil exporters and its economy is largely dependent on oil income, sanctions which were imposed on the Iranian economy mainly targeted the oil industry and restricted the trade in Iranian oil. Therefore, I analysed the oil exports using the Markov switching model.

The transition probability for oil exports which determines the probability of transitions between the states are presented in the Table below:

Table 4.7: Constant transition probabilities

	Oil export	
States	**1**	**2**
1	0.822	0.177
2	0.536	0.463

The table shows the Markov Transition Probabilities for oil exports which is the main target of the imposed sanctions and an important variable for the Iranian economy. This determines the probability of the variable transforming from the no sanctions regime to the sanction's regime. The transition probability is 0.822 and 0.463 for state 1 and 2 respectively.

4.5.5.1- Smoothing probabilities:

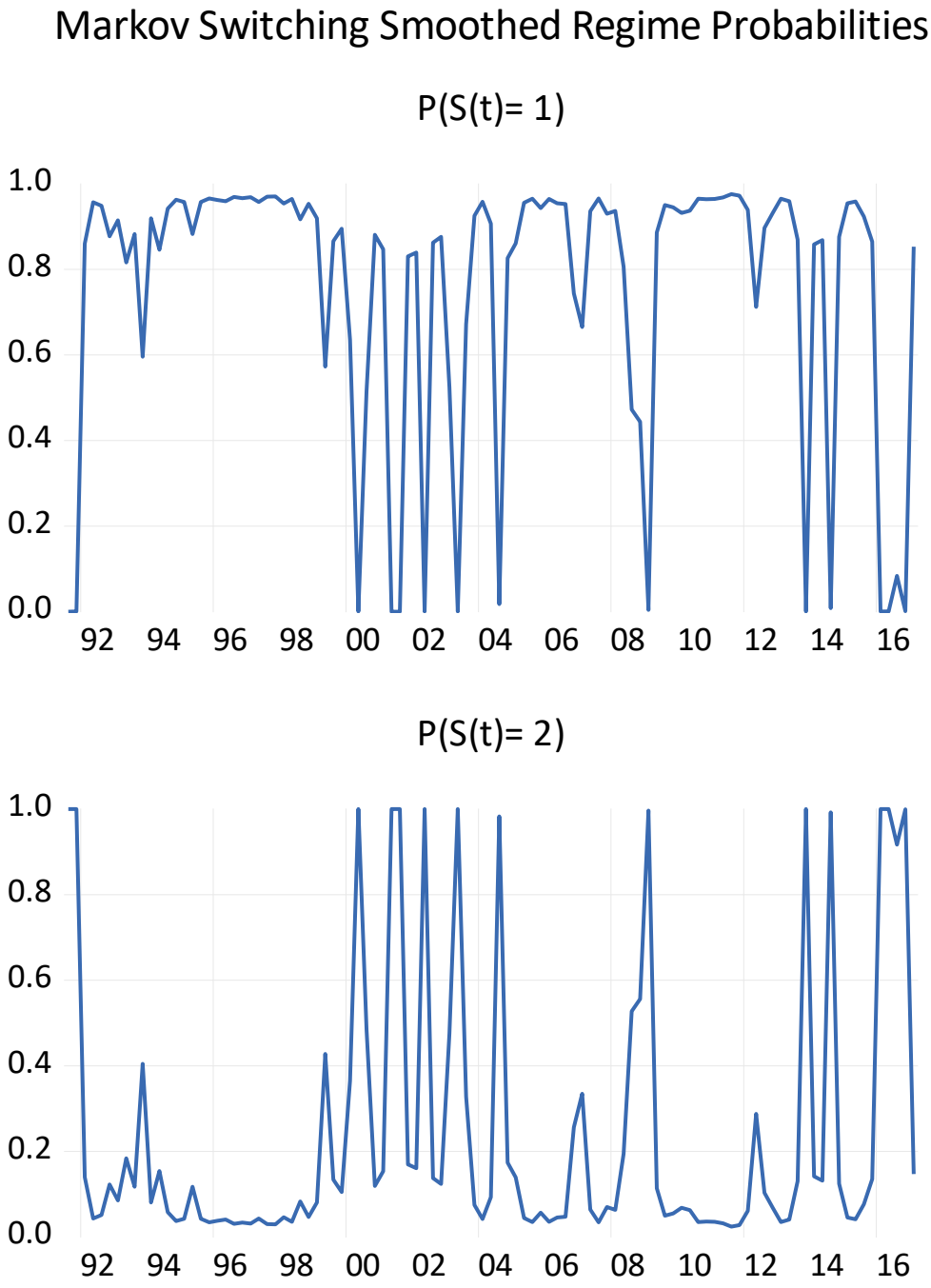
Smoothed probabilities are computed for oil exports to provide the structural breaks for when the shifts occurred. The change from one state to another happens when the probability is more than 0.5.

Table 4.8: Oil export

Variable	Coefficient	Std. Error	z-Statistic	Prob.
Regime 1				
C	0.01	0.03	0.48	0.62
LOG (σ)	-1.86	0.18	-10.07**	0.00
Regime 2				
C	-0.00	0.00	-1.80	0.07
LOG (σ)	-3.47	0.14	-23.87**	0.00
Transition Matrix Parameters				
P11-C	-0.28	0.80	-0.34	0.72
P21-C	-1.23	0.50	-2.43**	0.01

Notes: A ** (*) indicates significance at the 5% (10%) level.

Figure 4.3: Smoothed regime Probabilities for oil exports



The graph shows that the smoothed probabilities are greater than 50% in different events corresponding to structural breaks. Iran began to put more focus on nuclear programs in late 1980s and early 1990s, in 1992 congress passed an Act to forbid some goods and technology trades. In 1992 and 1995 Iran signed an agreement with Russia for developing nuclear programs. In 1995 there was a ban on US investments in Iran aimed at the oil and gas sector but companies where able to apply for licences to trade in the oil industry. in 1996 the Iranian sanctions act was imposed. In 1997 the IAEA had a safeguard agreement. In 1998 Ukraine did not sell turbines to Iran due to US pressure and in 2000 the US was allowed to sanction individuals and organisations involved in the nuclear program. Iran and Russia signed a nuclear cooperation in 2001. In 2002 Iran revealed the existence of some nuclear facilities. In 2003 Iran agreed to suspend the nuclear program. in 2005 US tightened the imposed sanctions.in 2006 US sanctions targeted the oil industry. Iran and the EU had talks on trade agreements during 2002 and 2005. In 2007 the UN voted for tightening the sanctions targeting the exports and the US extended sanctions, targeting the financial sector and in 2008 the UN imposed further sanctions on banks and asset freezes. UN sanctions were extended from 2012 to 2014. And in 2016 the Iran sanctions act was extended which was imposed by the US.

Expected duration:

The expected duration shows the time it takes for shifting between the states. As is shown in the table it takes a short time to transform between the states, so the effects of the shocks are immediate.

4.5- Conclusion:

The research was conducted to analyse the effects of sanctions on Iran's macroeconomy and to determine whether the imposed sanctions achieve their objectives. In addition, the research determines Iran's responses to imposed embargoes.

The literature review indicated that the government of Iran uses a number of strategies to countermeasure the imposed economic sanctions. However, the main strategies include (1) Seeking opportunities for small trading partners, (2) forming trading partners and alliances with Asian countries, (3) shifting to gasoline supplies, (4) diversifying its international trade routes, (5) establishing long-term regional economic partnerships, (6) development of local technology and local markets, and lastly (7) persuading non-American firms to violate the terms of the embargoes.

These strategies have successfully helped Iran evade the negative impact of the economic sanctions. As a result, the economy has been thriving despite the longstanding sanctions. Through these avenues, the country has found substantial international and regional markets for its oil exports. Iran's economy greatly depends on oil production. The country's economy could have been greatly affected if it couldn't find a substantial market for its oil exports. Despite the sanctions, Iran is still able to find a market for its oil exports. In addition, the embargo has not

affected the oil price. Iran finds markets for its oil imports mainly from eastern European countries such as Belarus and Asian markets like India, China, and Japan as well as Africa countries among others. The result show that sanctions affect mostly the Exchange Rate and the consumer price index. However, other macroeconomic variables such as the trade deficit, imports, oil export, and oil price are insignificantly affected by the economic sanctions. The result of the data analysis indicated that, in general, economic embargoes have negatively affected Iran's GDP. In particular, it has led to a slower economic growth rate because the country is unable to reach its full economic potential when it is blocked from accessing most international markets. Slow economic growth has also contributed to the high level of unemployment in the country. The strength of the local currency has also been severely affected, which eventually increased the export income. Low exchange rates imply that imported goods would be too expensive in Iran. In addition, the sanctions have contributed to the high level of inflation due to increasing CPI, which has affected the lives of the citizens by reducing their purchasing power and disposable income. Most household goods have become too expensive in Iran as inflation increases.

The patterns of the smoothed regime probabilities provide an important insight into the ability of economic sanctions to affect the exchange rates, GDP, and CPI. They explain the low economic growth experienced by the country over the years are associated with the economic embargoes. The changes in the probability patterns also provide additional evidence of the effect of embargoes in shifting trends in economic growth, real GDP, CPI, as well as the currency exchange rates.

From the analysis and the literature review, it is evident that economic sanctions have not achieved the objective of isolating and compelling Iran to suspend its nuclear activities. The country is able to find markets for its oil and use the money to spearhead nuclear programs. In addition, the country still finds access to major nuclear materials and equipment. The ban on joint ventures has not succeeded since Iran still finds allies with outer eastern European countries. The resolution to stop collaboration with Iran's credit and national banks has also failed to succeed.

The most appropriate approach to dealing with Iran could be to create commercial as well as inter-government agreements at the regional level. Organizations and institutions can play key roles in the creation of the necessary commercial agreements.

Despite the embargoes, Iran has not collapsed economically. it rather continues to improve in the global market due to the several counter responses it has implemented. The economic sanctions have not effectively succeeded in bringing down Iran's macroeconomy. Even though other sectors are affected, oil, which is the main economic driver in Iran, has not been negatively impacted by the sanctions. As the statistical analysis indicates, the oil prices and exports are not affected. However, other macroeconomic indicators such as the exchange rates, GDP, and CPI are affected. Therefore, if the macroeconomy is not greatly affected, there is no guarantee that the economic sanctions achieve their complete goal. The results from my study are in line with Simon (1996) who investigated the inflation and oil price shocks in Australia by using the Markov switching model. In addition, Morin (2000) indicated that the inflation rise is caused by the sanctions which can be also seen in this study. My study has investigated the exchange rate, but literature

investigating the relationship between sanctions and the exchange rate are rare. In line with Naghavi et al (2015) sanctions have led to stabilization over a long period of time rather than achieving the sanction's aim. The results from this chapter and the previous chapter both complement each other and both indicate that it is mostly the exchange rate that is the factor that is involved and affected by the shocks and imposed sanctions rather than the real economic factors in Iran's macroeconomy. In effect the exchange rate is acting as a shock absorber, its movements help restore the competitive balance of the economy and therefore benefit the real economy and ensure its stability. I can conclude that due to the fact that the objective of the imposing sanctions is not the exchange rate, they have not achieved their objective during the long time period.

4.7- APPENDICES

Appendix A: Gross Domestic Product (GDP)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
Regime 1				
C	0.012574	0.003553	3.538864	0.0004
LOG (σ)	-3.724367	0.139525	-26.69323	0.0000
Regime 2				
C	0.011413	0.014866	0.767738	0.4426
LOG (σ)	-2.866621	0.304659	-9.409271	0.0000
Transition Matrix Parameters				
P11-C	4.080005	1.207378	3.379229	0.0007
P21-C	-2.738769	1.989644	-1.376512	0.1687

Appendix B: Deficit

Variable	Coefficient	Std. Error	z-Statistic	Prob.
Regime 1				
C	-186.9467	5267.028	-0.035494	0.9717
LOG (σ)	10.43689	0.115481	90.37734	0.0000
Regime 2				
C	-84.25868	248.6784	-0.338826	0.7347
LOG (σ)	7.234598	0.177277	40.80949	0.0000
Transition Matrix Parameters				
P11-C	3.051685	0.907902	3.361249	0.0008
P21-C	-2.910682	0.857343	-3.395001	0.0007

Appendix C: Imports

Variable	Coefficient	Std. Error	z-Statistic	Prob.
Regime 1				
C	0.008233	0.016724	0.492300	0.6225
LOG (σ)	-2.001458	0.097287	-20.57263	0.0000
Regime 2				
C	-0.074121	0.211401	-0.350619	0.7259
LOG (σ)	-0.428016	0.255802	-1.673234	0.0943
Transition Matrix Parameters				
P11-C	3.341257	0.800495	4.173988	0.0000
P21-C	-1.082565	0.830715	-1.303173	0.1925

Appendix D: Oil Price

Variable	Coefficient	Std. Error	z-Statistic	Prob.
Regime 1				
C	-0.062054	0.133315	-0.465467	0.6416
LOG (σ)	-1.105292	0.310388	-3.561007	0.0004
Regime 2				
C	0.031709	0.013075	2.425186	0.0153
LOG (σ)	-2.299249	0.095631	-24.04303	0.0000
Transition Matrix Parameters				
P11-C	0.866443	1.195207	0.724932	0.4685
P21-C	-3.173796	0.915079	-3.468330	0.0005

Chapter 5:

Real Exchange Rate Misalignment in Iran

5.1- Introduction

As a criterion to measure the national currency equilibrium of a country versus other countries currency, the exchange rate indicates the economic status of the given country at the international level. As in the previous chapters it was evident that sanctions have had their main effect on the exchange rate, in this chapter I concentrate on the exchange rate and its value.

The deviation of the real exchange rate from its equilibrium value indicates the misalignment circumstances. Research studies about the exchange rate and effects of the exchange rate on macroeconomic variables shows that there is a negative relationship between the exchange rate misalignment and most macroeconomic variables. In this current study, I analyze the real exchange rate misalignment in Iran using the Gregory-Hansen co-integration method. Moreover, this chapter discusses the theoretical issues about the foreign exchange regimes and previous studies, and then models it for Iran and evaluates the results.

The exchange rate can be defined as the value of a country's currency with respect to another country's and the exchange rate regime refers to the currency system used that determines that rate and varies between fixed and flexible rates. The exchange rate regime is considered as one of the most important political tools of governments, and its choice has a significant impact on

the trade of goods and services, capital flows, inflation, balance of payments, and other economic variables. For this reason, the choice of exchange rate regime is an essential component for economic growth and stability. However, there is no agreement on how an appropriate exchange rate regime should be selected, as well as an ideal exchange rate regime suitable for all countries. Specific features of countries, policy makers' preferences, the credibility of institutions and policymakers can influence the choice of exchange rate regimes. Economic decisions, the size and openness of countries and financial flows, the rank of financial and economic development, the structure of production and trade, the recorded inflation and the types of shocks that countries face are among the most important factors influencing the choice of the exchange rate regime (Wang, 2010). The option of a floating exchange rate regime is chosen by most advanced countries, and currently emerging countries have also chosen it following the breakdown of a number of pegged regimes during the 1990s. In most cases, however, they face major problems in implementing it.

In an open economy, trading between countries and the flow of capital are affected by several variables and indicators, among the most important of them is the exchange rate. In addition to affecting exports, imports and capital flows, changes in the exchange rate can impact other economic indicators such as inflation and stock returns. Therefore, a considerable part of the economics literature has been devoted to the investigation of the open economy and exchange rate-related issues.

One of the most important issues which has received attention from economists and policymakers with regard to the exchange rate is the exchange rate misalignment phenomenon. The exchange rate misalignment associates to the deviation of the exchange rate from its

equilibrium path in the long run. The balance of payments crises in developing countries are often the result of real exchange rate deviations from their long-run equilibrium path (Mehrara, 2006). Economists agree that real exchange rate stabilization at an inappropriate level, as well as the persistence of this misalignment have affected economic wellbeing (Sallenave, 2010), economic growth (Harms et al, 2009), capital accumulation (Kandilov et al, 2011), direct foreign investment (Goldberg, 2009), export and diversification of exports (Freund et al, 2012), currency crisis (Bussiere et al. 2006), and trade balance (Hoffmann, 2007).

In spite of the studies conducted on the factors affecting the incidence of exchange rate misalignment, the study of exchange rate misalignment persistence has received scant attention from researchers. The existence of persistence in exchange rate misalignment can at least limit part of the efforts of policy makers to keep the general level of prices stable or improve economic growth. Iran has always experienced changes in nominal and real exchange rates over the past three decades. To calculate the exchange rate deviation, the equilibrium real exchange rate (erer) should be calculated first, and then, the amount of misalignment and deviation of the real exchange rate from equilibrium values should be calculated.

$$mis = \left[\frac{rer_t - erer_t}{rer_t}\right] \qquad (5.1)$$

In my study Purchasing Power Parity (PPP) is used, based on the CPI of Iran and the US, for determining the equilibrium, exchange rate as this is the most popular approach for measuring the equilibrium exchange rate.

In the next sections, the research literature is explored. The third section presents the historical context of exchange rate regimes in Iran followed by determining the exchange rate regime measurement and implication. Then research findings are presented. Finally, in the last section, the conclusion is presented.

4.6- Literature review

5.2.1- The literature on the selection of the exchange rate regime

generally, the literature on the characteristics of exchange rate regimes can be classified to three general classifications:

The first category consists of a part of the literature that focuses on the determination and recognition of the characteristics of the currency system. Articles by Marcus Fleming (1962) and Robert Mundell (1963) play a central role in this part of the literature. Mundell and Fleming have shown that if capital is highly mobile, then fixed and floating exchange rate regimes will have quite different outcomes when implementing a policy of economic stabilization. If monetary and fiscal policies are defined relative to nominal and real shocks, then a fixed exchange rate regime is exposed to nominal shocks, which would minimize production fluctuations, while the floating regime is more successful in accommodating real shocks.

The second category of the literature from Europe after World War II addresses the question of how exchange rate regimes can strengthen economic convergence (Barrow and Martin, 1992). There are two central questions in this literature:

First a fixed exchange rate regime is likely to reduce uncertainty and transaction costs, thereby encouraging and strengthening trade and investment between countries? Second, if a group of countries reach a certain degree of convergence, is it logical to sacrifice monetary policy (monetary policy independence) to maintain fixed exchange rates and ultimately become a monetary union?

The third category in the literature was influenced by the high inflation of the 1960s and 1970s and emphasizes aspects of the validity of monetary and exchange rate regimes (Gash et al., 1997). In these models, the central bank faces a problem of credibility, and this problem stems from its incentive to reduce unemployment (as well as the devaluation of nominal debt) by creating unpredictable inflation. When workers consider this factor in their wage demands, not only will unemployment not change, but higher inflation will also be achieved. In a closed economy, this can be solved by conferring power on a conservative central bank or gaining policy credibility through contractionary monetary policies. In an open economy, fixed and pegged exchange rates can be a good alternative to policy makers' credibility, since keeping fixed exchange rates can act as a nominal anchor and limit monetary policy. Under these circumstances, pegging the national currency to the currency of the country where the monetary policymaker has sufficient credibility will make the monetary policy of the country a function of monetary policy in the foreign country concerned. Of course, it should be noted that the political and non-political costs of a violation of fixed pegged exchange rate regimes are extremely high.

5.2.2- Theoretical studies

The real exchange rate is a suitable way to show the competitiveness of a country in the global markets and a method for measuring the cost of commercial goods produced inside the country. The reduction of the real exchange rate leads to an increase in the internal costs of commercial good production. The equilibrium real exchange rate determines the corresponding price of tradable goods to non-tradable goods in the long-run (Hinkle, 1999). Moreover, the equilibrium exchange rate demonstrates the persistence of the values of the variables affecting this rate (Hinkle, 1999). Among these variables we can generally refer to monetary, fiscal, commercial, and efficiency policies and terms of trade (Mehrara, 2005). A variety of approaches exist to calculate the equilibrium exchange rate, which are expressed in brief as follows.

One of the main theories for investigating equilibrium exchange rate is Purchasing Power Parity (PPP) theory. In this theory, the trading exchanges between countries are supposed to be completely unencumbered and unlimited. In line with purchasing power parity theory, we can determine that two different exchange rates are in equilibrium when the purchasing power of both currencies are equal. In fact, any deviation from the general level of relative prices will gradually disappear and the real exchange rate will converge to a constant value.

The main focus of this approach is in simultaneously achieving the conditions in which the internal and external balances are realized. The macroeconomic framework for calculating the equilibrium real exchange rate is a combination in which the current account balance is on the one side and the capital stock of public and private sectors on the other side. One of the other approaches to calculate the equilibrium exchange rate is the behavioral equilibrium exchange rate (BEER). In order to calculate the equilibrium exchange rate in this approach, one can use

econometric tools and judge the over valuation and under valuation by comparing its results with the real exchange rate. Among the most important determinants of the real exchange rate in the framework of the theoretical foundations, which are recognized as fundamental variables, are productivity growth, terms of trade, capital inflows and outflows, government size, capital accumulation and consumer preferences.

The terms of trade are one of the most important tools to analyse economic issues such as the benefits obtained from an open economy. The improvement of the terms of trade causes an increase in the real income of the country, and consequently, an increase in demand for tradable and non-tradable goods; however, as the price of tradable goods is determined internationally, the increased demand for this type of goods inside the country will not increase the price of these goods (Amano, 1995). But the price of non-tradable goods increases by increasing the terms of trade, and as the real exchange rate measures the ratio of the price of tradable goods to the price of non-tradable goods, an increase in the price of non-tradable goods causes a reduction in the real exchange rate. The results of some empirical studies have shown that there is a positive correlation between terms of trade and real exchange rate. Additionally, these studies have shown that various factors such as the type of currency exchange system and the degree of dependence on oil exports affect this correlation (Coudert et al., 2015).

An increase in capital inflows can occur due to various reasons, such as increased international aid, reduction of global interest rates, adjusting several regulatory rules to capital flows, an increase in public debts (due to supplying budget deficits from outside) and exogenous increases in external creditors' lending. The increased capital inflow causes an increase in the demand for tradable and non-tradable goods. Supposing that the price of tradable goods in a

small open economy is determined in global markets and is constant, and also as the real exchange rate can be defined as the price of non-tradable goods to the price of tradable goods ratio, the real exchange rate is strengthened in the long-term by increasing the price of non-tradable goods (Izadi 2011).

Based on the Balassa-Samuelson hypothesis (1964), the difference in relative productivity growth between two countries in the area of tradable goods to the non-tradable goods leads to real exchange rate variation. Based on this hypothesis, increasing relative efficiency in one economy compared to another economy will lead to an increase in the real monetary value. Government spending is regarded as one of the main tools for economic stabilization policy.

Results obtained from empirical studies show that a rise in government spending can increase the price level inside the country and weaken the real exchange rates. However, in some studies it has also been stated that this relationship will be an inverse relationship. The government's decisions on how to allocate spending between tradable and non-tradable goods and the type of imposed tax will affect the long-run real exchange rate. Additionally, the increased government spending affects the real exchange rate as long as they cause an increase in the demand for non-tradable goods versus tradable goods (Ravn et al., 2012).

Having defined the equilibrium exchange rate, the question arises as to what the exchange rate misalignment is and how it is measured.

The exchange rate misalignment can be defined as a gap between the real exchange rate and its equilibrium value. And the equilibrium exchange rate cab ne used as th basis for a corresponding misalignment measurement. The exchange rate misalignment is one of the key

variables in the realm of policy in developing economies and its calculation is one of the main issues in the open macroeconomic area. Choosing a proper level for the equilibrium real exchange rate is very important due to its effect on the internal and external balance, and misalignment, whether positive or negative, can disrupt the optimal allocation of resources and, consequently, reduce welfare and create economic and social crisis. Undervaluation of the exchange rate in terms of external balance can lead to the current account surplus due to the profitability of exports and the reduction of imports. In contrast, over valuation can lead to a current account deficit.

The exchange rate misalignment is one of the factors affecting imbalances in an open economy. According to some studies, most of the financial crises during the past two decades have occurred in countries in which the exchange rate system has been fixed or crawling over the years leading up to the crisis. Among them we can refer to financial crises in Mexico (1994-1995), Southeast Asia (1997), Russia (1998), Brazil (1999), Turkey (2001), and Argentina (2002). However, based on macroeconomic models, it is not possible to clearly state which system creates greater misalignment in the exchange rate because each of the exchange rates bring their own characteristics. Within a floating exchange rate system, the currency market determines the nominal exchange rate. Therefore, the real exchange rate misalignment is temporary. In contrast, considering that it is impossible to adjust the nominal exchange rate in the fixed exchange rate system, the risk of real exchange rate misalignment increases. However, if the goods market is completely efficient, even if the nominal exchange rate is constant, prices can return the real exchange rate to its equilibrium value in response to market pressure (Sekkat, 2015). Misalignment may occur in both fixed and floating systems for different reasons (Coudert et al, 2013) in a fixed currency system, this can occur due to price

stickiness and use of monetary and fiscal policies, and in the floating exchange rate system, it occurs due to incomplete information.

Engel (2010) believes that one of the main reasons for misalignment is stickiness in prices, and in general, monetary and fiscal policies. In most research studies, in order to investigate persistence, only the existence of a unit root has been investigated. However, this framework is largely unrealistic and restrictive. For example, some empirical evidence and economic theories indicate that many macroeconomic variables have different reactions other than those of I (1) and I (0) conditions. In order to resolve this limitation, flexible models were presented that included both I (0) and I (1) states, and thus included a wider range of persistence behaviors in the variable under consideration.

In some of the studies conducted on the persistence of economic variables, long memory and ARFIMA models were used to measure and assess the persistence value (Agostinelli and Bisaglia, 2010: p. 1574). The existence of long memory indicates that an impulse has a long-term effect on a variable. Additionally, the existence of long memory and persistence is not the only characteristic of nonstationary processes and can be observed in stationary processes as well. The existence of this characteristic can be investigated by I (d), where d is the degree of integration by differencing. In ARFIMA models, the degree of integration can be both an integer number and a fractional number.

5.2.3- Empirical studies on developing countries

Asgari and Toufighi (2010) investigated factors affecting exchange rate misalignment and its effect on economic growth during a period between 1959 and 2007 in Iran. In their research

study, they defined misalignment as the percentage difference between the real exchange rate and equilibrium real exchange rate. According to the findings of this research, the exchange rate misalignment had a negative effect on economic growth.

MacDonald and Vieira (2010) investigated the role of the real exchange rate misalignment on the economic growth of a set of 90 countries[4] using the generalized methods of moment (GMM) method and the time series data spanned the period 1980-2001, the researchers showed that the exchange rate misalignment has a strong influence on economic growth. Their results showed negative coefficients and as a result they concluded long-run growth decreased the greater RER misalignment was.

Barghandan and Najafi (2010) investigated the effect of the exchange rate deviation on the index of Agricultural Producer Support in Iran using an autoregressive distributed lag (ARDL) model. For investigating the long run relationship between the variables the ARDL model has been used and the existence of the long run relationship is determined. After calculating the real exchange rate, the long run equilibrium exchange rate and its deviation were calculated. According to the results obtained from this study, the economy's degree of openness and the world real interest rate have a negative effect on the real exchange rate. The deviation from the

[4] List of countries: Algeria, Argentina, Australia, Bahrain, Bangladesh, Belgium, Bolivia, Botswana, Brazil, Burkina Faso, Cameroon, Canada, Chile, China, Colombia, Congo, Congo DR, Costa Rica, Ivory Coast, Denmark, Dominican Republic, Ecuador, Egypt, El Salvador, Ethiopia, Finland, France, Gabon, Germany, Ghana, Greece, Guatemala, Haiti, Honduras, Hong Kong, Iceland, India, Indonesia, Iran, Ireland, Israel, Italy, Jamaica, Japan, Jordan, Kenya, Korea, Kuwait, Madagascar, Malawi, Malaysia, Mali, Malta, Mexico, Morocco, Netherlands, New Zealand, Nicaragua, Niger, Nigeria, Norway, Oman, Pakistan, Panama, Papua New, Paraguay, Peru, Philippines, Portugal, Saudi Arabia, Senegal, Singapore, South Africa, Spain, Sri Lanka, Sudan, Sweden, Switzerland, Syria, Thailand, Togo, Trinidad & Tobago, Tunisia, Turkey, Uganda, United Kingdom, Uruguay, Venezuela, Zambia

real exchange rate shows the size and amount of support required for the agricultural producers to be less than real value.

Hosseini et al. (2010) investigated the effect of the real exchange rate deviations on the index of wheat producers' support in Iran during the time period between 1989 and 1997 using the vector error correction (VEC) model. According to the results of this study, the equilibrium exchange rate had deviated in the given time period and this deviation led to a hidden tax being received from wheat producers.

Mohamadi and Nabizadeh (2013) investigated the long run relationship between the real exchange rate misalignment and the import of intermediate, capital, and consumable goods in Iran during the period between 1974 and 2011 using fully-modified ordinary least square method (FMOLS). In their study they have calculated the long run real equilibrium exchange rate and determined the exchange rate fluctuations. They indicated the significant effect of exchange rate misalignment on imports in the long run. Same as Barghandan and Najafi (2010) this approach the long run relationship as investigated. According to the results of this research, the real exchange rate has deviated from the equilibrium path. Additionally, during the period under investigation, the real exchange rate misalignment has caused a reduction in production. The present study has introduced innovations from two perspectives compared to the previous national studies. First of all, in the majority of studies conducted in this area, the PPP method is used to calculate the real exchange rate deviation from equilibrium values. This is despite there being no consensus on establishing the required assumptions for using this model, including full flexibility of the price level and trading without any limitation in the Iranian economy. Additionally, in these studies which have used the behavioral equilibrium model,

some of the most effective factors such as the degree of openness are not taken into account. Second, in spite of the effect of the persistence of the real exchange rate misalignment on macroeconomic variables, the existence of this persistence in the exchange rate misalignment has not been investigated in previous studies.

Musyoki et al. (2014) investigated the real exchange rate misalignment in the period between 2003 and 1993 in Kenya using the VAR method. This study is based on single equation and Vector Autoregressive (VAR) specification. These researchers showed that the cause of the exchange rate misalignment is the overvaluation of the real exchange rate. According to the findings obtained by theses researchers, the exchange rate misalignment has caused a reduction in the economic growth in Kenya.

Bachar et al. (2014) indicated the persistence of real exchange rate misalignment in Morocco from 1980 to 2012, they show that misalignment persistence can be explained by structural characteristics of the economy such as lack of productivity and degree of openness. Caputo (2015) investigated the persistence of real exchange rate misalignment for 54 developed and developing countries[5] over the period 1980-2011. The findings indicate that in developing countries fixed exchange rate regimes decrease the real exchange rate adjustment and misalignment persistent increase. Caputo (2015) indicated that in a fixed exchange rate regime the exchange rate convergence to its equilibrium is takes place slowly. This is true for

[5] List of countries: Australia, Algeria, Belgium, Belize, Brazil, Canada, Chile, China, Colombia, Costa Rica, Cyprus, Cote dlvoire, Denmark, Dominica, Ecuador, Finland, France, Germany, Greece, Gabon, Gambia, Hong Kong, Iceland, Ireland, Italy, Indonesia, Israel, Japan, Lesotho, Malaysia, Mexico, Netherlands, New Zealand, Norway, Nicaragua, Portugal, Pakistan, Paua New Guinea, Paraguay, Peru, Philippines, Spain, Sweden, Switzerland, Singapore, South Africa, Thailand, Trinidad and Tobago, Tunisia, United Kingdom, United states, Uruguay, Venezuela, Zambia.

the developing countries in comparison with the developed countries. In Iran the government has tight control on the economy and the exchange rate.

5.3- Theoretical issues from a historical point of view:

The new common classification of foreign exchange rate regimes includes nine items as follows which is represented by the IMF[6]:

1- Truly fixed arrangements

2- An exchange rate regime based on a currency board in which monetary authorities maintain 100% of the reserves in terms of foreign currency against the monetary base. Any change in the balance of payments makes the same changes in the money supply and does not play a role in establishing internal credit.

3- Dollarization and complete removal of national currency (systems based on foreign currency in which domestic money is completely eliminated).

4- A currency union in which members choose a single currency.

5- An adjustable peg, in which minor changes are applied periodically.

6- A crawling peg is moderated with a series of changes made in the national currency.

7- A basket peg of currencies when the exchange rate is fixed to a weighted basket of foreign currency.

[6] IMF exchange rate arrangements

8- Target Zone or Bands is the domain in which the exchange rate is determined, and monetary authorities interfere when the exchange rate is withdrawn from the target range.

9- Floating and managed floating. A variety of foreign exchange rate regimes are shown in Table (1):

Table 5.1. Types of currency regimes

<table>
<tr><th>Floating exchange rate regimes</th><th>Median exchange rate regimes</th><th>Fixed exchange rate regimes</th></tr>
<tr><td rowspan="2">Managed Floating</td><td>Adjustable Peg</td><td>Currency Union</td></tr>
<tr><td>Crawling Peg</td><td>Currency Board</td></tr>
<tr><td rowspan="2">Floating</td><td>Basket Peg</td><td rowspan="2">Fully fixed system</td></tr>
<tr><td>Target Zone or Bands</td></tr>
</table>

Source: personal collection from IMF

Different types of exchange rate regimes have been described in Table since 1880.

Although 15 exchange rate regimes, are described by Reinhart and Rogoff (2004), the main choice between a fixed and floating regime is still the focus of the discussion of exchange rate regimes.

Table 5.2. The typology of exchange rate regimes over the years (1880-2000)

1880-1914	**Gold standard-based (single or bimetallic), Currency Union, Currency Board, Floating**
1919-1945	**Currency exchange systems based on gold exchange, Floating, Managed Floating, Currency Union, Fully Floating**
1946-1971	**Bretton Woods Adjustable Peg, Floating (Canada), 2 or more rate**
1973-2000	**Free-floating, managed floating, adjustable pegs, crawling Peg, Basket Peg, target area or range, Currency Union, Currency Board**

Source: personal collection

The choice of exchange rate regime in the past century was a very simple matter. The exchange rate choice at that time was between the gold standard as the fixed exchange rate regime on one side and floating rates on the other.

What is now apparent from the experience of the floating system between World War I and World War II is that this system has been accompanied by instability caused by speculation, poverty and devaluation (Narks, 1944).

This led to the creation of the Bretton Woods system, which was an adjustable peg system, in 1944. Many countries, after the Bretton Woods system, have accepted monetary arrangements in which the exchange rate of the countries is pegged to a fixed rate in the dollar. In this system, the dollar was pegged to gold and allowed to fluctuate by 2.5%, and countries had the right to change their value against other currencies in case of fundamental inequality.

Friedman (1953), in response to Narks popular opinion (1944), introduced a new point on the floating exchange regime. According to Friedman, the floating exchange rate has privileges such as monetary autonomy, the buffering against actual shocks, and fewer problems in the

adjustment mechanism. Mundell (1961) developed Friedman's analysis by raising capital mobility. According to this analysis, Fleming's theory (1962), the choice between a fixed and floating exchange rate regime, depends on the origin of the nominal and real shocks and on the degree of capital mobility. Based on this view in a capital-intensive economy, exchange rate flotation protects the country against real shocks, such as a shift in export demand or exchange relations. A fixed exchange rate regime is suited to deal with nominal shocks, such as a change in demand for money.

The optimum currency area is defined as a geographic region in which having a single currency and a single currency policy is the best option as noted by Frankel (1999). In economic studies, the optimum currency area is also known as the optimal currency region (OCR), and is intended to be the geographical area in which the economic efficiency will be maximized if there is a single currency in that area. The optimal currency region (OCR) describes the optimal features for integrating money by creating a new currency. Based on the theory of optimum currency area, the benefits of fixed exchange rates increase relative to the level of integration between countries. According to the rational expectations model, an increase in money supply creates a predictable inflation that is unhelpful in reducing unemployment. However, only the creation of an earlier binding mechanism for the introduction of a monetary rule can prevent the mismanagement of economic policy makers at such times. A pegged exchange rate may also facilitate a framework for such an agreement in an open economy (Chang and Velasco, 2001).

5.4- Exchange rate regimes in terms of measurement and implementation

To select an exchange rate regime, it is important to have empirical evidence of the economic performance of these regimes. However, before dealing with these studies, exchange rate regimes should first be classified. There are two types of exchange rate regime classification:

First, Classification based on the De juro and De facto exchange rate regime

And second, a category that is known as the fear of floating and disreputation of policies, is presented by Calvo and Reinhard (2000) and Levy-Yati Petty Schwartzinger (2001), and is according to the behaviour of countries and their economies.

The IMF's annual reports on currency arrangements and its constraints are the main source of information on foreign exchange policies pursued by countries. This type of classification can be used to develop and improve currency arrangements over time, determining factors for the choice of exchange rate regimes by countries, and the dependence of exchange rate arrangements and their economic performance. Since the exchange rate policies that are expressed by countries are considered to be truly equivalent to what they really follow, this method is known as the official classification. Although, after the Bretton Woods period, no country has the obligation to adhere to what it claims as its exchange rate regime. Due to differences between the state's declared policies and what is actually in place, recently a new classifier of exchange rate arrangements has emerged.

The need for this new classification during the Asian crisis, when the difference between real and reported exchange rates appeared, became very important. The most famous category was taken by Reinhart and Rogoff (2004) and Levi Yeyati and Sturzenegger (2005). These

classifications may vary in detail, but all emphasize the true behaviour of the exchange rate. In other words, the new classification of what countries are doing in practice is the norm, not what is stated in the reports. In this way, this classification is known as a real currency arrangement. The new real classification seems to have completely succeeded the official classification.

According to Rogoff (2004), between September 1981 and late 2001, the Swiss franc followed a real crawling range of less than or equal to +/- 0.02. In fact, the country's monetary policy, which is in keeping with the interest rate stability, is misleading due to being a free-floating exchange rate regime. Another example is Canada, which was classified as a crawling exchange rate regime in a given domain, between June 1970 and December 2001 for 30 years.

The old classification (official) is still appropriate to answer some questions. On this issue, it is common ground that the adoption of a floating exchange rate regime does not determine the monetary policy strategy. In this way, it is quite possible that the monetary policy pursued by a country under the floating exchange rate regime will lead to a constant exchange rate, as shown by the Swiss example. In general, if we are interested in explaining the monetary policy of a country, what the central bank says to the general public may be important. If we look at the true behaviour of the exchange rate, what Calvo and Reinhart have called the fear of floating exchange rates exists, and when we judge it by the central bank's policy announcements, we find that the exchange rate will remain constant.

There are several reasons why countries actually have fixed exchange rates or seem to have fixed exchange rates without having to commit to a fixed exchange rate regime. One example is the Swiss state, where the stable exchange rate in the market is the side effect of the monetary

policy strategy, in which the exchange rate is one of the many variables that the central bank should monitor.

The second reason for this is that the central bank is aware that the economy is sometimes affected by shocks that require significant exchange rate adjustments, and the central bank does not want to commit to a specific exchange rate that may make the adjustment process difficult.

The third reason for not announcing the exchange rate is the fear that the target rate will attract speculation and the value of the national currency will be reduced.

These discussions indicate that in order to understand how exchange rate arrangements affect economic performance, attention to both nominal and real classification is necessary. The classification of exchange rate arrangements in the table below is better understood.

Table 5.3. Classification of exchange rate arrangements

		Real Classification	
Official Classification		Fixed	**Float**
	Fixed	A	**B**
	Float	C	**D**

Cells A and D show the exchange rate classification according to what actually happens in the market is the same as what the authorities say. Square B shows the exchange rate regime that has been announced as fixed by the central bank, but in practice exchange rate fluctuations

exist, and this lack of compliance by the central bank will have negative consequences for the economy. Cell C shows the fear of fluctuations in exchange rates, which Calvo and Reinhart have pointed out.

There are many studies that test if the official classification reflects all information about the real behaviour of the exchange rate. For example, one of these studies was done by Carre and Voltine (2002), which examined the relationship between fluctuations in the true effective exchange rate and nominal exchange rate. They used both the official and true classifications and found significant differences between the exchange rate changes in the official classification. In particular, true exchange rate fluctuations in regimes officially declared to be floating, but fixed in practice, are much more than the exchange rate regimes that are either floating or fixed formally and in practice. This suggests that doing what monetary authorities officially announce will cause lower fluctuations in exchange rates compared to what can be interpreted differently from the announced policies.

In another study, Alsina and Wagner (2003) explained why in some countries there is a difference between what they are doing and what they say. They found differences in the quality of monetary institutions and found evidence that in countries where the exchange rate regime is announced as fixed, but it is floating in practice (such as cell B), the quality of legal entities is worse than those countries that according to the real classification of the exchange rate regime, have announced it floating but it's fixed in practice (like cell C). They interpreted that both groups are worried that extreme exchange rate fluctuations (especially in terms of devaluation) are considered by market agents as a symbol of their management weakness. In other words, both groups are attempting to peg the exchange rate more than formally reported

to transmit the signs of stability. Rogoff et al. (2003) examined both approaches from the point of view of cost-benefit analysis and studied the practical capabilities of each of the categories. They divided the IMF countries according to the exchange rate experience into three categories; developing countries with limited access to emerging market capital markets, with free access to capital markets and advanced countries. This study examines the historical durability of foreign exchange rate regimes and the functioning of alternative exchange rate regimes, focusing on developing and emerging economies.

However, the findings confirm that the emerging economies developing for organizational and economic reasons need to consider the adoption of a flexible exchange rate regime. Also, they conclude that fixed or relatively inflexible exchange rate regimes in poor countries did not have a bad performance. It seems that countries with weak financial markets and closed capital markets are better off with the fixed exchange rate to some extent without losing much of their economic growth, albeit on the important condition that monetary policy is in harmony with a non-official parallel market and prevents it from fluctuating. They also point out that exchange rate flexibility for developed countries that are not members of a monetary union seems to allow for more growth, without these countries needing tools such as central bank independence and a clear anti-inflationary position.

Gash et al. (2002) used combined data for 147 countries in the thirty-year period (1970-1970). They conclude that according to the International Monetary Fund's classification, countries that have pegged their national currency have experienced lower inflation than those countries with moderate foreign exchange rate regimes, such as crawling peg or managed floating. Among them, the only exception is advanced countries. With a better classification of foreign exchange

rate regimes, they conclude that countries that peg their national currency rigorously have the lowest inflation rates, and other pegged exchange rate regimes still have lower rates of inflation compared to more flexible regimes.

Findings of Louis Pathy and Schwarzenegger (2001) do not differ significantly from the results of the study by Gash et al. (2002). They conclude by their own classification that there is little difference in the rate of inflation between non-oil economies, irrespective of the foreign exchange system that they had over the years (1974-1999). Of course, this is not true of countries that have pegged the price rigorously, as well as countries that have had at least 5 years of soft pegging, and these countries have low inflation, compared with countries that follow other exchange rate regimes.

Bellini and Francisco (2005) obtained similar results from Levi-yeyati and Sturzenegger (2001) and Gash et al. (2002). As a result of this, vigorous pegging of the exchange rate is significantly associated with lower inflation. However, for countries with constant and sustained inflation, there is little difference between inflation rates, regardless of whether their exchange rate regime is soft peg or float peg.

The results of a study by Hussein et al. (2005) show that in developing countries (with the exception of emerging markets), the exchange rate flexibility is associated with higher inflation, but their findings do not differentiate between the vigorous and soft exchange rate fluctuations and their relation to inflation. Bellini and Francisco (2007) examined the relationship between exchange rate regimes and macroeconomic performance. They conclude that a sharp pegging of the exchange rate is beneficial from the point of view of inflation control, although floating exchange rates are not always associated with higher inflation rates

compared to soft pegging. In addition, if exchange rate regimes are classified according to the actual algorithm, then any obvious correlation between inflation and the exchange rate regime can be considered as a sub-product of different algorithms, which, of course, can be quite complicated and put different exchange rate regimes in different groups.

Levy Yeyati and Sturzenegger (2005) examined the factors influencing the choice of the foreign exchange system in a study on the endogeneity of the foreign exchange system. The studies provide three approaches to the choice of the foreign exchange system: (1) the theory of the optimal area of exchange; (2) the financial approach, which emphasizes the effects of international financial convergence; and (3) The view of political economy that emphasizes the exchange rate in order to strengthen economies facing political challenges. Using the division of the De jure and De facto foreign exchange system, this study examines these theories in a single and concise way. The results of this study support empirically all three of these theories. The political and financial variables in the industrial and non-industrial economies have different outcomes. In addition, the relationship between de facto division and its fundamental variables is remarkably stable over time, indicating that global trends, which are often emphasized in studies, have their effects on the evolution of its natural determinants, and practical policies have little effect on the changes and the twists and turns of the exchange rate system. Iran tries to keep the official nominal exchange rate fixed and it has become overvalued.

5.4.1: Iran's exchange rate:

Iran's exchange rate history starts with the Gold standard. Iran joined the IMF (international monetary fund) in 1946 when one Dollar was 32.50 Iranian Rial. Since 1953 the black market

was developed because of the political problems. In 1955 Iran had eight different exchange rates. In 1967 Iran experienced economic progress and political stability mostly due to oil revenue and increases in oil prices. Also, the black market almost came to an end. This boom continued over the following years. In 1974 two different exchange rates was established. In 1979 due to the revolution the exchange rate fell and the black market appeared and the exchange rate system was a controlled floating rate. The exchange rate continued to weaken till 1983 after which it started to rise but shortly afterwards the exchange rate declined again in 1984. By 1993 there were unification plans when the rate was almost the same as the floating rate. In 1995 due to the controls and foreign banns the black-market rate increased (depreciated) rapidly. And this trend has continued over years till now.

Iran's exchange rate has been volatile and depreciating over time which can have negative effects on macroeconomic variables such as GDP growth. Iran has faced at least two exchange rates since 1980s. Iran has a fixed exchange rate and also a floating black-market exchange rate and the gap between the two exchange rates has increased over time. Iran has used a multi-exchange rate system which has not been successful. The black-market exchange rate was 2400 Iranian currency to the US dollar in 1993 and the government determined a unification policy following the IMF consultation to unify the multiple rate into one exchange rate (Bahmani, 1995). However, this policy was not successful. There are two exchange rates in Iran, one the formal fixed rate by the Central Bank of Iran which has been used for government imports and oil exports and the open market exchange rate which is used for public and private businesses. As a result of the sanctions there has more pressure on the private sector and individuals.

5.5- Modelling and estimation results

5.5.1 Data

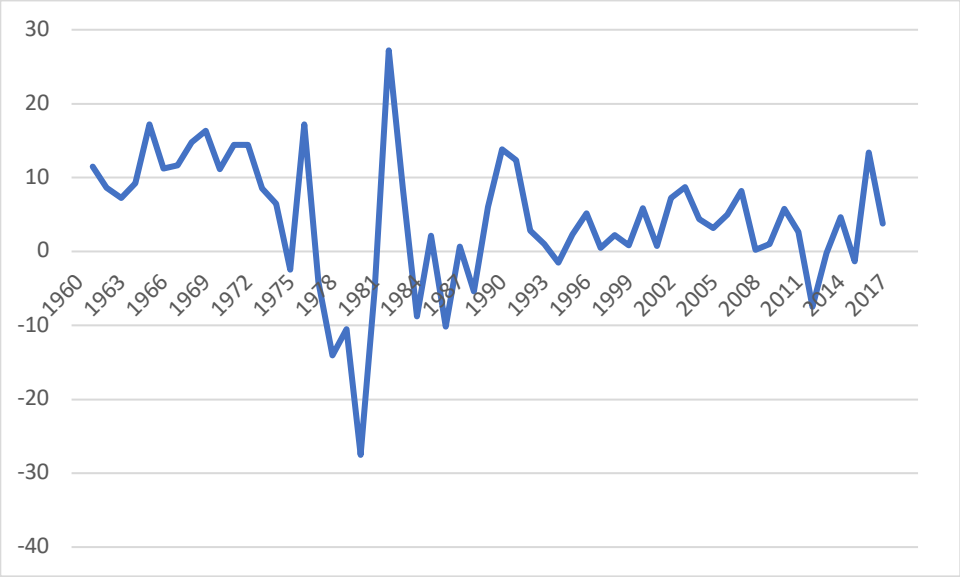
The quarterly data is obtained from the IMF, the Central Bank of Iran and WEO database from 1990 to 2016 focusing on Iran's GDP, the real effective exchange rate is from the IMF and the Central Bank of Iran provides the data for oil revenue, liquidity, interest rate and stock market index. The variables are in logarithmic forms. According to the variables of interest the simple long-run model we have is:

RER= α_0+α_1.OilRevenue+α_2.Liquidity+α_3.GDP+α_4.InterestRate+α_5.StockMarketIndex

Iran's GDP growth:

The Gross Domestic Product (GDP) has an average rate of 3.9 %. With the peak of 23 % in 1992 and a lowest amount of -16% in 2008. Real GDP Growth is calculated from quarterly data.

Figure 5.1: GDP growth



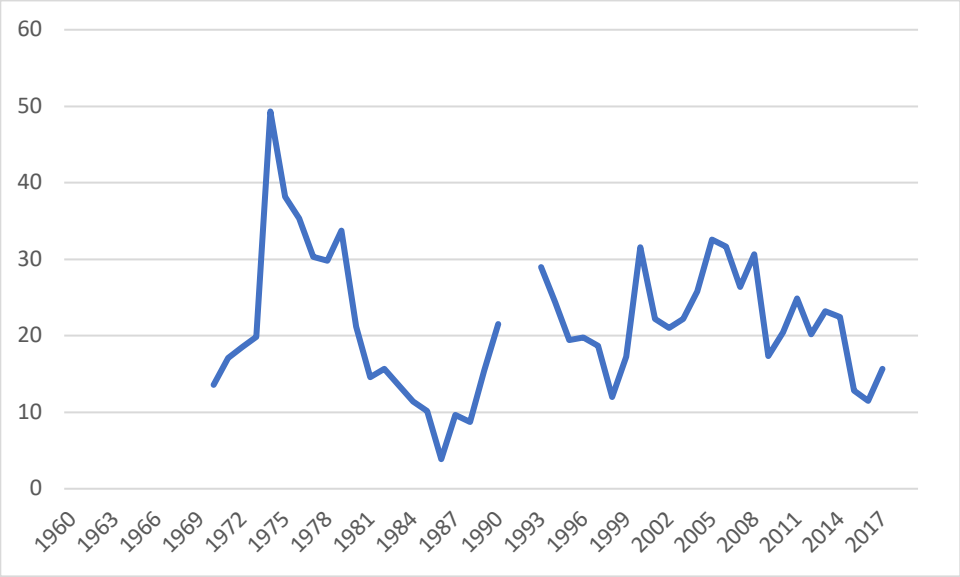
Source: personal collection

Iran's oil Revenue:

The average value of the oil revenue is 22 percent with the lowest value of 4 percent in 1986 and a peak of 50 percent in 1974.

Iran's Crude Oil Exports have an average of 2,202.300 Barrel/Day with the maximum of 2,684.100 Barrel/Day 2004. The data from the central bank of Iran has missing data from 1990 and 1993 which the data is extracted from the different Iran's financial reports, the world bank and the IMF database.

Figure 5.2: oil revenue

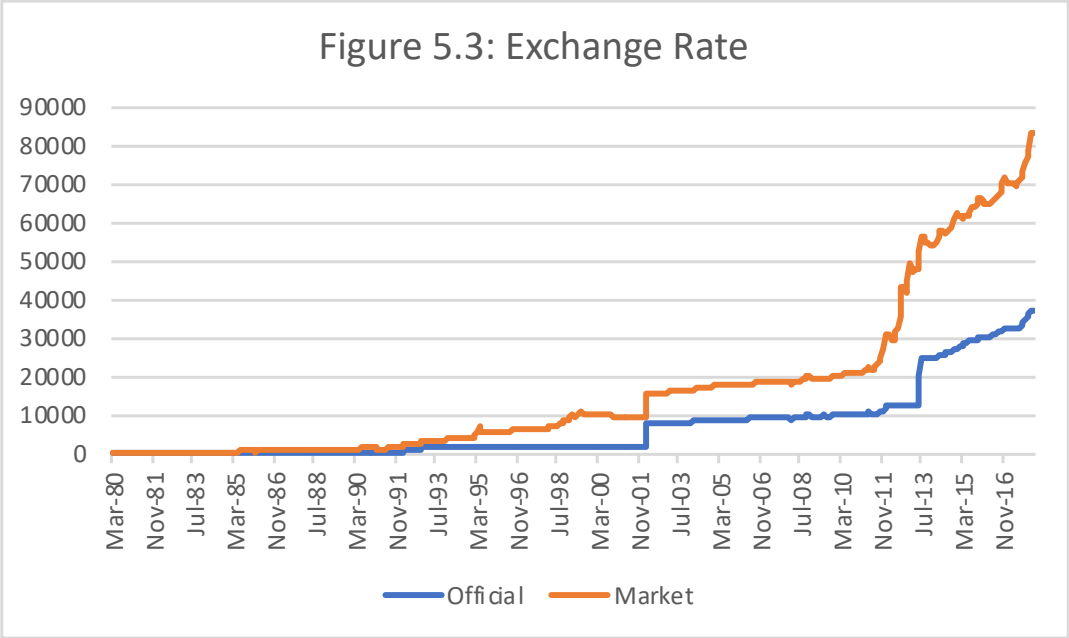


Source: personal collection

Iran's Exchange Rate:

Iran has faced multiple exchange rate during the last decades. The official exchange rate which is a fixed rate by the Central Bank of Iran and the market exchange rate which is a floating exchange rate as below.

Figure 5.3: Exchange Rate



Source: personal collection

5.5.2 Research Method

According to Rogoff et al (2003) and Courdet et al (2011), Mehrara (2006) and Macdonald (2000), an open-ended macroeconomic model is used, with the assumption that the capital account is open. In this model, supply shocks, demand and monetary policy are considered. The model is as follows:

$$y_t^s = \beta[\pi_t - \pi_t^e | I(t-1)] + \bar{y} + \gamma_t \qquad (5.2)$$

$$y_t^d = \alpha[s_t + p_t^* - p_t] + y_t^* + \varepsilon_t \qquad (5.3)$$

$$m_t - p_t = hy_t - \tau i_t + u_t \qquad (5.4)$$

$$\mathrm{i_t} = i_t^* + (s_{t+1}^e - s_t) \qquad (5.5)$$

Equation (5.2) is a supply function in which y_t is logarithm of production, y^d is used for the demand and y^s is for supply shocks. π_t *is* the inflation rate, and π_t^e is the expected inflation. Past and current values of variables and current and future policy shocks (including targeting in the inflation rate and nominal exchange rate) are available in the existing data set I (t-1). $\bar{y}$ is natural production level and γ_t is supply shock. Equation (5.3) is the IS curve or the total demand of an open economy. s_t is logarithmic nominal exchange rate, p_t^* foreign prices and p_t is domestic prices. In equation (5.4), the equilibrium conditions are in the money market. m_t denotes the logarithm of the volume of money, h is the elasticity of money demand and τ the elasticity of demand. m_t is a monetary policy tool for economic stability. For a fixed exchange rate regime, the money supply is targeted at the exchange rate. Obviously, in a fixed exchange rate regime, the discussion of temporal incompatibility does not mean a difference in the exchange rate in the case of a rule and discretionary monetary policy, while in a floating exchange rate regime, the money supply can be used as a tool for discretionary monetary behaviour. Assuming that the monetary authority is pledged to a rule, monetary policy follows a rule to ensure a zero or low rate of inflation.

Equation (5.5) represents the conditions for the equalization of uncovered interest parity. In view of the above relations, the central bank's objective function, known in the literature as the loss function, is expanded as follows:

$$L = \lambda_1(\pi_t - \pi^*)^2 + \lambda_2(y_t - ky^*)^2 + \lambda_3(s_t - s^*)^2 \qquad (5.6)$$

According to equation (5.6), the central bank wants to determine the tool at a time horizon to minimize the loss function. On the other hand, Taylor's rule, known as the most popular monetary policy rule, can be considered. Therefore, in a fixed exchange rate regime, the rule for monetary policy is as follows:

$$m_t = \bar{s} + \frac{\alpha h - 1}{\alpha} v_t + u_t + \frac{1}{\alpha} \varepsilon_t \qquad (5.7)$$

In this case, changes in monetary policy are followed by adjusting the exchange rate at a constant value of $\bar{s}$. This targeting is based on shocks in supply, demand and monetary policy. In these conditions, production and inflation are as follows:

$$y_t = \bar{y} + \frac{\beta}{\alpha+\beta} \varepsilon_t + \frac{\alpha}{\alpha+\beta} v_t \qquad (5.8)$$

$$\pi_t = \frac{I}{\alpha+\beta} (\varepsilon_t - \gamma_t) \qquad (5.9)$$

It is observed that production and inflation have been affected by supply and demand shocks, and monetary policy has not affected them in this approach. In this case, the monetary policy controls only the exchange rate.

While in a fixed exchange rate regime, the policy of discretion is not relevant, in the floating exchange rate regime, the rule can vary from the discretionary policy. If the conditions are an obligation, the monetary authority by choosing a policy rule (zero inflation rate or target exchange rate) during the t-1 period will allow for a regular formation of the expectations of individuals. In terms of accruals, the optimal inflation rate chosen by the monetary authority

and the expected inflation rate selected by the individuals will not be different. So, production will change around its natural value:

$$y_t = \bar{y} + \gamma_t \tag{5.10}$$

Therefore, the expected social loss function is as follows:

$$(l_t^c)^e = (k - I)\bar{y}^2 + \sigma_v^2 \tag{5.11}$$

The loss function is a critical component in optimization problems, such as estimation, policymaking, statistical decision making, forecasting and financial investment. Optimal monetary policy and its parameters can be obtained from minimizing a social loss function. The central bank monetary policy objective involves minimizing the loss function of the exchange rate and inflation.

In the case of discretion where the monetary authority chooses an active policy, if the nominal exchange rate is targeted, the equations will be:

$$m_t = p_{t-1} + u_t + \frac{\beta - wh}{w + \beta^2} v_t + [\frac{\beta}{w}(k - I) + h]\bar{y} \tag{5.12}$$

$$\pi_t = \frac{(k-I)\beta}{w}\bar{y} + \frac{\beta}{w+\beta^2} v_t \tag{5.13}$$

$$y_t = \bar{y} + \frac{w}{w+\beta^2} v_t \tag{5.14}$$

Comparing the results in two terms of commitment and discretion reflects inflationary fluctuations and distortions in the exchange rate. Therefore, the expected social loss function is as follows:

$$\left(l_t^d\right)^e = (k-I)^2\bar{y}^2\left[I+\frac{\beta^2}{w}\right]+\frac{w}{w+\beta^2}\sigma_v^2 \qquad (5.15)$$

By solving the above equations for the exchange rate, the deviation in the nominal exchange rate can be written down in the difference between the terms of the commitment and the discretion:

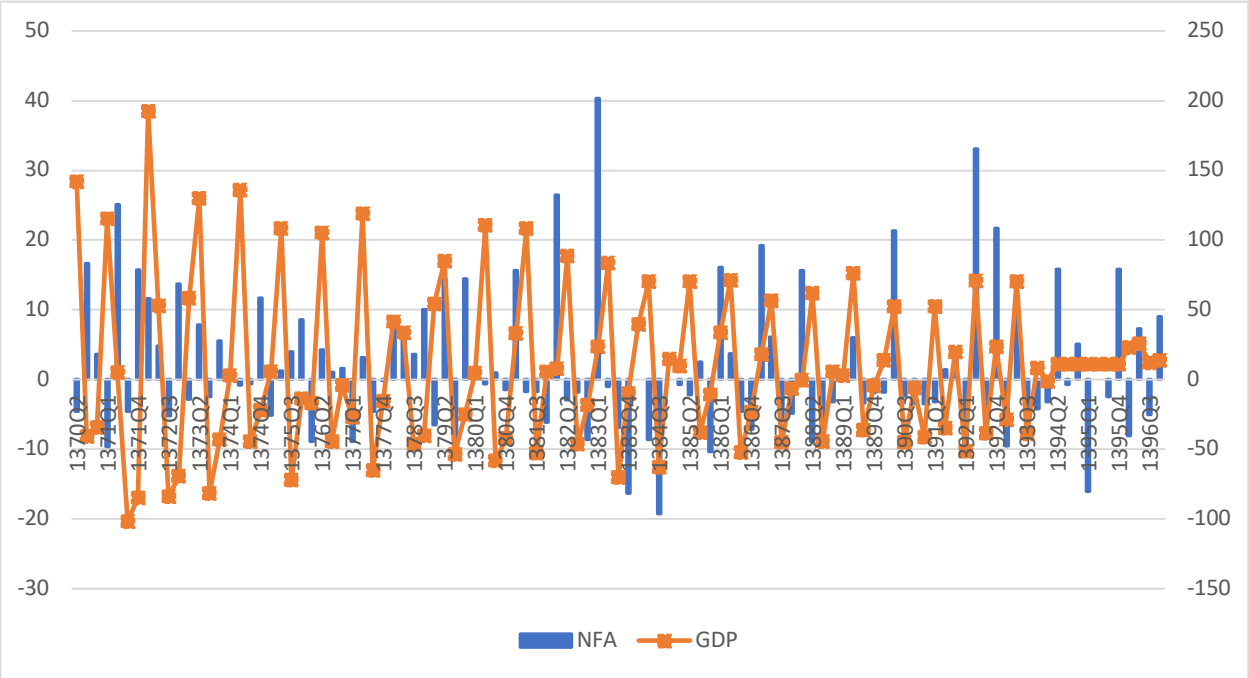
(5.16)

$$s_t = \frac{\alpha+\beta}{\alpha(I+h\beta)}m_t+\frac{\beta(\alpha h-I)}{\alpha(I+h\beta)}p_t^e+\frac{I-\alpha h}{\alpha(I+h\beta)}\bar{y}+\frac{I-\alpha h}{\alpha(I+h\beta)}v_t-\frac{\alpha+\beta}{\alpha(I+h\beta)}u_t-\frac{\varepsilon_t}{\alpha}+\frac{(\alpha+\beta)\gamma}{\alpha(I+h\beta)}(s_{t+1}^e-s_t)$$

It is shown that the deviation in the nominal exchange rate is a function of the volume of money, supply shock, demand shock, monetary policy shock, expected prices and the natural rate of production.

The graph below shows the time trends of GDP and net assets changes. As shown in figure (5.4), the trend of changes in GDP as a result of changes in the value of foreign assets is positively correlated.

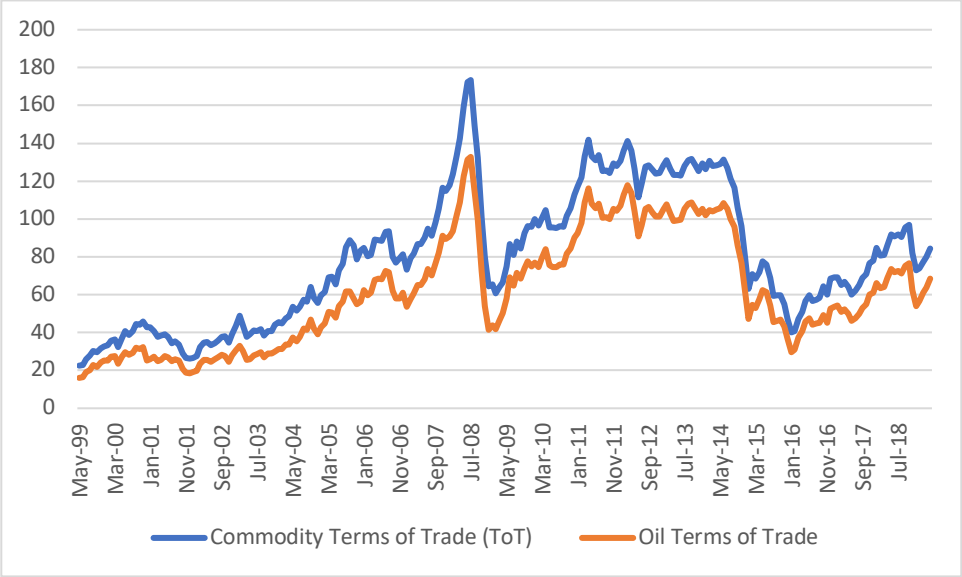
Figure 5.4: Changes in gross domestic product and net foreign asset value of Iran



Source: personal collection

The chart below shows the relationship between commodity prices and the price of oil in the long run. As can be seen, there is a one to one relationship between these variables in the long run.

Figure 5.5: The time trend of the relationship between the exchange of goods and the price of oil



Source: personal collection

5.5.3- Unit root test of the research variables

Considering that most of the economic time series models imply spurious relationships between the variables, it is important to test for the existence of a unit root in the variables. Firstly, to determine the existence of unit roots all the variables are tested by using the Augmented Dickey Fuller (ADF) test due to the fact that it is a common and popular approach for testing unit roots in the variables. secondly, the Gregory and Hansen (1996) cointegration approach is used to test for the cointegration between the variables. I am interested in studying the long run relationships with structural breaks due to the existence of breaks as a result of the sanctions.

Using the ADF approach, the unit root test indicate that the null hypothesis is not rejected so the time series has a unit root. The results are presented in the below table:

Table 5.4:

Variables	**ADF**
exchange rate	-1.71
Oil revenue	-1.60
GDP	-1.82
First differenced exchange rate	-5.01
First differenced oil revenue	-10.76
First differenced GDP	-3.24
Critical value at 5%	-2.89

Source: personal collection

In addition to the ADF test I have also used the Zivot-Andrews test which endogenously capture a structural break in the REER. In the first step, the Zivot and Andrews test was used to test for the unit root against structural instability. The null hypothesis of this test suggests that the root of the unit has no structural break, and the opposite hypothesis states that the desired series has a static process with a structural break. Structural break tests can help to detect the existence of significant changes in the data.

5.5.4- integration test

After performing unit root tests with structural breaks, the Gregory-Hansen co-integration test was used to examine the long-run relationship between variables with a structural break. The Gregory-Hansen test statistic is used in three modes (C), which indicates the level change, the state (C/T), which indicates the change in the surface along with the trend and mode, (C/S), which indicates the regime change. The results of this test are presented in Table (5). According

to the results presented in Table (5), it can be concluded that there is a relationship between the variables in terms of the structural break and these variables have co-movement in the long run.

5.5.4.1- Gregory-Hansen (1996) co-integration test

I use the Gregory and Hansen (1996) residual-based test for cointegration to test for structural break. Gregory Hansen co-integration model is an extension of the Engle and Granger model whilst allowing for structural breaks. It has been used previously for determining long -run money demand relationships along with the structural breaks in these models, as in Bhaskara and Kumar (2007).

The Engle and Granger cointegration approach with no structural break is of the form:

$$y_t = \mu + \alpha_1 x_t + \alpha_2 z_t + \alpha_3 e_t + \varepsilon_t \qquad (5.17)$$

Where the variables are I (1). In this study, our variables are the exchange rate, oil revenue and GDP.

$$exchangerate_t = \mu + \alpha_1 oilrevenue_t + \alpha_2 GDP_t + \varepsilon_t \qquad (5.17)$$

The structural change can be determined in changes in the intercept and parameters. The Gregory-Hansen test is used to allow an endogenous structural break in the series. This method is an expansion of the Engle and Granger (1987) method with a structural break included. The null hypothesis is no cointegration and the alternative hypothesis is the existence of

cointegration with a structural break. There is a single shift in regimes and the date is unknown. Gregory and Hansen extended the Engle and Granger approach by defining a dummy variable such as:

$$\varphi = \begin{cases} 0, if\ t \leq k \\ 1, if\ t > k \end{cases} \quad (5.18)$$

In which k shows the break date. For the cointegration test with structural breaks, three models are determined which are the level shift (C), the level shift with trend(C/T), and the intercept with slope shifts (C/S).

C Model:

The simple model with a level shift in the cointegrating relationship is below. Showing a change in the intercept and the other parameters are constant. Where μ_1 is before the shift and μ_2 is after the shift.

$$y_t = \mu + \mu_2\varphi_t + \alpha_1 x_t + \alpha_2 z_t + \alpha_3 e_t + \varepsilon_t \quad (5.19)$$

C/T Model:

β represents the trend coefficient.

$$y_t = \mu + \mu_2\varphi_t + \beta_t + \alpha_1 x_t + \alpha_2 z_t + \alpha_3 e_t + \varepsilon_t \quad (5.20)$$

C/S Model:

$$y_t = \mu + \mu_2\varphi_t + \alpha_1 x_t + \alpha_{11}\varphi_t x_t + \alpha_2 z_t + \alpha_{22}\varphi_t z_t + \alpha_3 e_t + \alpha_{33}\varphi_t e_t + \varepsilon_t \quad (5.21)$$

The Gregory and Hansen (1996) cointegration test indicates the existence of an unknown break date, which is presented by calculating the usual statistics for all break points and selecting the smallest values.

The breaks dates that are selected accord with the application of significant sanctions which are in 2008 when the UN Security Council applied sanctions on banks cargo planes and ships carrying previously sanctioned items. and further asset freezes were applied. Also, in 2010 the UN Security Council imposed more sanctions on Iran with financial curbs and an expanded arms embargo. Also, Iran was banned from buying heavy weapons such as attack helicopters and missiles. Also, US sanctions were tightened in the energy sector and new sanctions were imposed on petroleum companies trades. The EU also imposed further sanctions on sectors such as trade, financial services, energy and further asset freezes.

Table (5.6) presents the results of the Gregory-Hansen co-integration test. The three Gregory-Hansen models are estimated by OLS with a trend and proceed with the ADF test. The break date is 2008 and the null hypothesis of no cointegration is rejected.

Table (5.6): Results of Gregory-Hansen co-integration test

(C/S)			(C/T)			(C)			Model
Z_t	Z_α	ADF	Z_t	Z_α	ADF	Z_t	Z_α	ADF	
-61	-7.86	-7.23	-52.3	-5.11	-5.43	-46.4	-5.02	-5.22	t-stat
2008	2008	2010	2008	2008	2010	2008	2008	2010	Breakdown Year

(C/S)		(C/T)		(C)		Critical value
10%	5%	10%	5%	10%	5%	
-5.41	-5.62	-4.74	-5.11	-4.22	-4.44	ADF
-5.41	-5.62	-4.74	-5.11	-4.22	-4.43	Z_t
-54.2	-60.2	-39.9	-48.2	-35.98	-41.5	Z_α

Source: Research findings

5.5.5- Empirical research model

In this section, the empirical model is examined and fitted. The purpose of this study is to examine the effect of monetary policy on the choice of exchange rate as an anchor in the economy in the long-run and investigate the deviation of the exchange rate from PPP. The choice of exchange rate as the nominal anchor for monetary policy is considered as follows:

$$s_t = \frac{\alpha+\beta}{\alpha(I+h\beta)} m_t + \frac{\beta(\alpha h-I)}{\alpha(I+h\beta)} p_t^e + \frac{I-\alpha h}{\alpha(I+h\beta)} \bar{y} + \frac{I-\alpha h}{\alpha(I+h\beta)} v_t - \frac{\alpha+\beta}{\alpha(I+h\beta)} u_t - \frac{\varepsilon_t}{\alpha} + \frac{(\alpha+\beta)\gamma}{\alpha(I+h\beta)} (s_{t+1}^e - s_t)$$

(5.22)

As we can see, the deviation in the nominal exchange rate is a function of the volume of money, a supply shock, a demand shock, a monetary policy shock, expected prices and the natural rate of production. The results are shown after the estimation of the equation, using the selected variables and estimated results. Accordingly, the parameters are estimated by time intervals.

Table (5.7): The results of estimating the factors affecting the exchange rate misalignment

Exchange rate deviation in fixed regime	**Exchange rate deviation in floating regime**	**Variables**
0.61 (0.01)	0.29 (0.02)	**Intercept**
0.55 (0.09)	0.19 (0.01)	**exchange rate misalignment lag**
-0.22 (0.00	-0.07 (0.02)	**Production gap**
0.002 (0.03)	0/008 (0.02)	**Inflation gap**
-0.25 (0.01)	-2.41 (0.01)	**Oil revenue**
111.73	139.98	**WALD statistic**
0.81	0.92	**R^2**

Source: Research findings (numbers in brackets are p values)

As can be seen, all the variables used in each model are statistically significant and the coefficients are also consistent with economic theories. In the estimated regression, based on the results of the Wald test, which has a distribution of χ^2 with degrees of freedom equal to the number of explanatory variables minus the constant component, the null hypotheses are the

estimates are significantly different to zero for all coefficients at a significance level of 5%. As a result, the validity of the estimated coefficients is confirmed. Based on the results of this test, the variables used in the model estimation are valid. As a result, the validity of the results is verified for interpretation. The R-squared statistic estimation of the estimated model is 0.87 and 0.79, which indicates the explanation of 87 and 79 percent of the estimated models.

When analysing the exchange rate and the macroeconomy, the diagnostic tests are important due to the fact that it validates the parameter estimation outcomes. Serial correlation occurs when the error terms are correlated. Examining the time series, it happens when the errors related to observations in a specific time period continue to a future time period. The Durbin-Watson statistic can be used to test for the existence of serial correlation in the residuals. The LM test can be used for examining the higher order serial correlation. The diagnostic tests undertaken include the normality and serial correlation tests. The Ramsey RESET and Jacque-Bera normality test approaches are used to examine features of the residuals.

Table 5.8: Diagnostic tests

Test	**Null Hypothesis**	**t-statistics**	**Probability**
Langrage Multiplier	No serial correlation	16.77	0.59
Jacque-Bera Normality	There is a normal distribution	6.12	0.04
Ramsey RESET test	No significant explanatory power	0.82	0.59

Source: Research Findings

Since we are using time series data with a unit root and we have found evidence of cointegration we are also using the error correction model (ECM) to explain the short-run dynamic nature of the relationship. Using the Error correction approach indicates the exchange rate movement

back towards equilibrium following a shock to the model. We can also indicate the causality between the variables and determine which variable causes the other variable using this approach. Moreover, our dependent variable is the different exchange rate. ECM (-1) denotes the lagged error correction term. The error correction model gives better results in terms of the short run relationships and can be used with non-stationary series. The error term indicates the significance of any disequilibrium between our variables in the previous period and the speed of adjustment to the equilibrium. The ECM coefficient determines how quickly the relationship go back to its equilibrium with a significant error correction term indicating the existence of a stable long-term relationship. In this study all variables are differenced and the residuals from the model are used to form the error correction term. No lags to the variables are needed as there is no autocorrelation.

By using the error correction model (ECM) we can estimate short-run coefficients. The error correction model indicates the quickness of returning to the equilibrium in the model. A significant error correction coefficient demonstrates the presence of a reliable long-run relationship (Bannerjee *et al.*1998), the Error correction model estimates the short run coefficients and error correction term that determines the speed of adjustment toward equilibrium. The error correction coefficient is -0.43. according to the error correction term the adjustment towards the equilibrium is gradually with 43% adjustment one quarter later.

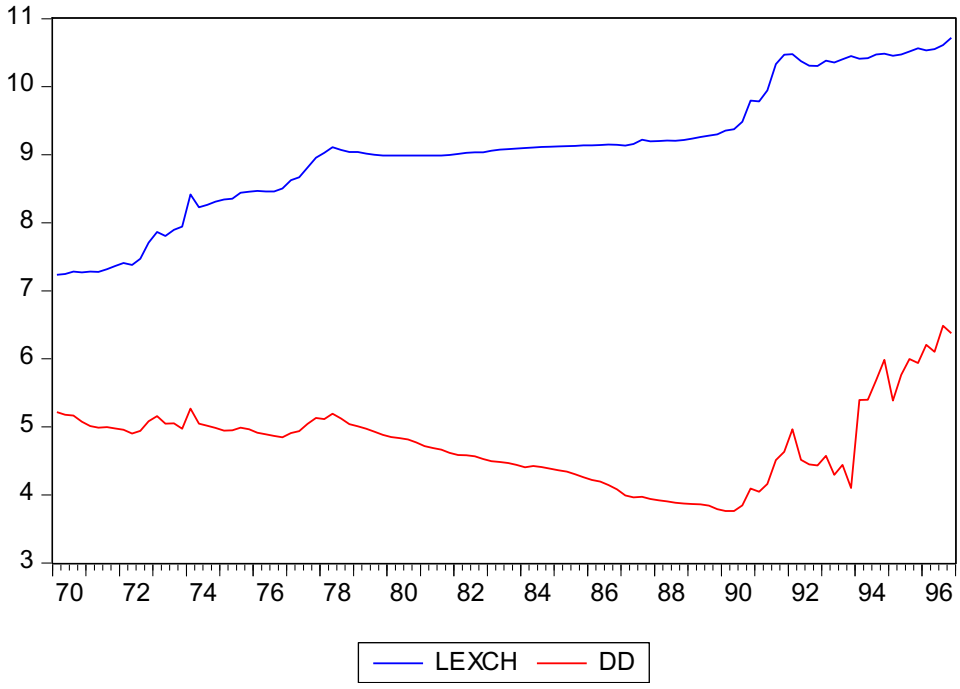
Table (5.9): The error-correction model of exchange rate equation

Regressors	Coefficient	Standard Error	T-ratio (Prob)
LnGDP	-0.09	0.04	-2.89 (.002)
LnOilRevenue	-0.65	0.01	-5.17 (.000)
LExchangeRate	0.20	0.02	3.89 (.000)
Intercept	1.00	0.02	3.00 (.009)
ECM (-1)	-0.42	0.05	-4.12 (.000)

The results indicate that the effect of the production gap on reducing the exchange rate divergence in the floating exchange rate regime is more than the fixed exchange rate regime. The coefficient obtained indicates that, taking into account the purpose of the exchange rate, using monetary policy to reduce the production diversion leads to a decrease in the exchange rate deviation from the target amount to 0.06 and -0.11 in the fixed and floating exchange rate regimes respectively.

On the other hand, based on the estimated coefficients, the deviation of the inflation rate in the floating exchange rate regime is less than the fixed exchange regime. This suggests that when the monetary policy target is the exchange rate, the policymaker's requirement is the rate of monetary growth is based on the rule, which leads to the fact that the deviation in the rate of inflation in the fixed exchange rate regime has more severe effects on the exchange rate deviation than in the floating exchange rate regime. The coefficients of the inflation rate gap in the fixed and floating exchange rate regime are 0.008 and 0.002, respectively.

Figure 5.6: The time trend of the real exchange rate (LEXCH) and deviation of the exchange rate (DD)



Source: research findings

In addition, the effect of oil revenues on the exchange rate deviation from the target rate in the fixed exchange rate regime is higher than the interval floating exchange rate regime. The coefficient on oil revenues on the reduction of the exchange rate deviation in the fixed exchange rate system and floating interval is 0.36 and 0.25, respectively. In fact, given that in the fixed exchange rate regime, the monetary authority loses control over inflation; their efforts will be to control the volatility and exchange rate divergence, which indicates the greater effects of the oil revenues on the reduction of the exchange rate divergence in the fixed exchange rate regime.

Finally, the effect of liquidity growth on the exchange rate deviation in the floating exchange rate regime is less than the fixed exchange rate regime. These coefficients in these systems are 0.09 and 0.17, respectively. Given the mode of targeting, the exchange rate has two effects on

the production gap and prices. The stability of the exchange rate in total demand creates stability, and, on the other hand, the exchange rate influences the level of prices through the supply sector because the nominal exchange rate will affect the prices through the cost of imported intermediate goods. The targeting or stabilization of the exchange rate is also important in other respects, because, on the one hand, fluctuation in the exchange rate results in the reallocation of resources between the production sectors. On the other hand, exchange rate fluctuations impose foreign constraints on the domestic policies of the economy because the shocks that originate in a single economy will spread to the various sectors of the economy. Since, if currency is stabilized, price stability is eliminated, depending on the economic conditions and conditions of each country, it may be favourable at one point of time following the course of the exchange rate targeting, and at other stages of time it may not be a good policy.

5.6- Conclusion

The present study investigates the effect of monetary policy in Iran's economy with the approach of exchange rate targeting. In choosing an exchange rate regime, the components of the political economy were also considered. In a country with a fixed exchange rate regime, fixing a currency to foreign currencies will stabilize the value of its currency and will provide conditions for increasing the credibility of policy makers, while the floating exchange rate regime has the potential to confront the effects of foreign shocks. In addition, the use of a fixed exchange rate regime has led to a reduction in the uncertainty of the real sector of the economy, which could improve international trade and domestic investment, while the use of a floating exchange rate regime can lead to the independence of monetary policy in the face of foreign

shocks, therefore it can be regarded as a tool for stabilizing the economy at the time of the existence of the business cycle.

Given that the announced nominal anchor for monetary policy in oil-exporting countries is the rate of liquidity growth, the degree of compliance of its rate with the actual values of the economy indicates that the ability and credibility of monetary policymakers are weak in implementing the announced policies. In fact, the difference between the planned amounts and the achieved amounts of exchange rate variables, inflation, and economic growth indicate the ineffectiveness of monetary policy. Regarding the continuation of growth rates above the announced targets of liquidity, it can be concluded that the performance of the central bank has had an expansionary bias and has led to a weakening of the monetary policy credibility. However, the performance of the entire period reflects a deviation in the monetary policy performance from the goals of growth of monetary aggregates, exchange rate, inflation and economic growth. The extent of this diversion has varied considerably over time, due to oil revenues and different approaches to economic and monetary policy. Proposals can be made to implement disciplined monetary policy in the banking system, so that most policies are based on the rule and prevent financial discipline and the surprise of agents.

Chapter 6: Conclusion

Sanctions are becoming more and more common as a tool for policy makers to gain their objectives. The aim of the sanctions is to have a negative effect on the targeted economy to persuade the government to change policies. However, the effects may be different regarding the target country's economy, political situation and international relations. Although the existing literature has determined the ineffectiveness of sanctions, the number using this as a policy tool is increasing. This study empirically analyses the effects of sanctions on macroeconomic variables such as GDP, oil exports, CPI, official and market exchange rates, imports and the deficit for Iran. Iran has faced significant unilateral US sanctions in combination with multilateral sanctions from the UN and EU. Iran has faced different kinds of sanctions aimed at the economy, financial sector and trade. Using the period of time from 1990 to 2017 for Iran when a succession of sanctions were applied I have shown that overall the sanctions have not been particularly successful with the Iranian exchange rate buffering the effects. The depreciation of the currency has increased inflation, but allowed the rest of the economy to continue largely as normal. This is partly because Iran's exports, mainly oil are now more competitive, especially to countries not taking part in the sanctions. In some ways this reflects how Iceland recovered from the financial crisis shock to its economy, with the depreciating exchange rate buffering the rest of the economy. I have used different methods to analyse sanctions such as the asymmetric vector autoregressive model and the Markov switching model.

Moreover, the impact of monetary policy on the Iranian economy has been investigated through exchange rate deviations. Overall with regard to the exchange rate, economic growth, monetary

policy have been ineffective and most of the time has not gained the expected result. The Central Bank of Iran has tried to control the exchange rate while the floating black-market exchange rate was in existence. I have shown that there are exchange rate misalignments which have widened over time. Oil revenue has had more effect on the exchange rate misalignment in the fixed exchange rate regime than the floating exchange rate regime. Also, the effects of liquidity growth on the exchange rate misalignment has been more in the fixed regime than the floating regime. Sanctions imposed on the Central Bank of Iran in 2012 affected the oil export market and economic sanctions in 2012 have had a significant effect on the exchange rate. Central bank of Iran's report on monetary variables indicate that liquidity has increase significantly between 2013 and 2020 and at the same period of time Iran's economic growth is fluctuated between zero and one percent. Budget deficit is one of the main reasons of increase in liquidity growth which also is a result of increase in inflation. Moreover, central bank of Iran is dependent to the government and government debt to central bank is increasing. Along with the imposed sanctions, liquidity growth and corruption have caused the Iranian currency decrease significantly.

Iran has used different strategies to offset the effect of sanctions with the main approach involving shifting to alternative trading partners and offering deals encouraging the partners to cooperate with Iran. Iran was subsequently able to reduce the effects of sanctions through these strategies and allowing the exchange rate depreciation to restore Iran's competitiveness internationally. The Markov switching regime results have shown that the exchange rate and CPI have been affected by sanctions significantly rather than other macroeconomic variables such as the deficit, imports and oil exports.

Sanctions have had a negative effect on GDP and this could be mostly due to oil and gas sanctions and dependency of Iran on its oil revenue and the loss of oil exports due to the imposed sanctions. The high inflation suffered by Iran has reduced the purchasing power of individuals too, suggesting that not all Iran's strategies to overcome sanctions have been entirely successful. Overall the smoothed probabilities have shown an effect of sanctions in shifting trends in GDP, CPI and exchange rate.

The variance decomposition in the VAR model indicates that the negative oil price shocks had more of an effect than positive oil price shocks in the long run impact on the exchange rate. However, oil export shocks do not have a significant effect on GDP and the deficit but the deficit has a 15% effect on the consumer price index. Oil exports have significant effects on the exchange rate. Imports are not affected significantly by other macroeconomic indicators. According to the impulse response functions of the vector autoregressive model, oil export shocks have negative impacts on the consumer price index and exchange rate although the effect on the deficit and imports is insignificant.

International financial sanctions have limited Iran's oil revenues and Iran faced a sharp decrease in its currency. Haidar (2015) argued that although sanctions may not reduce the total exports of Iran although export costs have increased. In the case of sanctions imposed on the oil sector, if the aim of these sanctions is a sharp reduction in oil exports, this strategy has not been effective. Moreover, as long as there are ways to shift trade from countries to other countries it will reduce the effectiveness of sanctions. Regarding isolating Iran to stop the nuclear program and preventing foreigners from collaborating with Iran's credit markets, the sanctions were again not successful and Iran's economy has not collapsed. In addition, despite

the embargoes on the oil sector, the effect on oil exports and prices are not significant. Although other factors such as the exchange rate, CPI and gross domestic product are affected more. As long as some of the macroeconomic variables are unaffected, then the goal of sanctions have not been achieved. However, some may conclude sanctions to be successful because of the agreement in 2015. But there have been disagreements and more sanctions again after this agreement. In general, the effects of sanctions on Iran have been moderate.

Policy Implications and further Research:

The policy implications of this study are that using sanctions to target specific industries such as oil tend to be ineffective, sanctions need to target those areas and industries where there are not alternative markets in other countries for those products. There will always be demand for oil, so possible sanctions should switch to other potential export markets for Iran. In addition, multilateral sanctions tend to be more effective rather than unilateral sanctions in obtaining their objectives. As the exchange rate is affected significantly by the sanctions, policy makers may focus more on this indicator when deciding on appropriate sanctions. If the cost of sanctions for the target country are not sufficiently damaging, they won't change their behaviour.

In the future, when more data becomes available additional studies are required to analyse the effects of sanctions on the Iranian oil sector. Moreover, other monetary variables can be added to complement the ones used here. This study could also include other factors affecting the Iranian economy such as corruption and compare it with the effects of sanctions on the Iranian macroeconomy to determine which factors have the most significant affect. In addition, the political economic consequences of the imposed sanctions could be studied in conjunction with

the economy. In this study estimations were limited by some lack of data. The sanctions were treated as homogenous but in reality, some sanctions are more effective than others. Future research could define the strength of the sanctions as well as more specific timing. Results could potentially be transferable to other countries as the exchange rate is the main factor of interest, any country that has a flexible exchange rate can be investigated. In general, the sanctions effectiveness is weak and the economic sanctions are limited and they pursue different targets, so future research could assess different countries, where alternative sanctions have been applied.

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